G. THAILAND

Contents

1. INTRODUCTION

This chapter examines recent trends in bioenergy policies and laws in Thailand. It begins with a summary of the energy sector with a focus on bioenergy production, promotion and use, as well as its future prospects. Next, the national legal framework in which bioenergy is developed is explored, including references to aspects such as the Clean Development Mechanism of the Kyoto Protocol. The third section takes a closer look at Thailand's bioenergy policy framework and related legislation and is followed by observations on the regional framework for bioenergy. Conclusions and recommendations for the bioenergy sector in Thailand are put forward in the final section.

1.1 Overview of Thailand's energy sector in recent years

Thailand's demand for energy has increased significantly over recent 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 percent of the gross domestic product (GDP) in 2004 to 10 percent in 2008. This situation represents the combined effects of the contracting global economy, a potential decrease in demand 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 percent.[190] In 2007, Thailand's energy make-up was: 47 percent from oil; 33 percent from natural gas; 14 percent from coal; 2 percent was derived from hydropower while 4 percent was from other sources.

Energy use in Thailand in 2007 was primarily consumed in transportation (37 percent) and industry (36 percent), with more modest use in the residential (14.79 percent), commercial (6.64 percent) and agricultural sectors (5.57 percent). 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.

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 – amounting to 12 percent of its

[190] World Bank. 2008.

GDP) are being implemented through tax reductions, direct transfers to 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 percent in 2007. The goal in the National Alternative Energy Development Plan adopted in March 2009 is to increase the share of renewable energy to 8 percent by 2011 and 20 percent by 2020.

1.2 Future prospects for bioenergy

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. Mandatory B2 biodiesel production guarantees and prices have created a favourable condition for growth but 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. Although exporting surplus ethanol is an option, production for these purposes requires case-by-case approval by the Ministry of Commerce. Thailand exported around 70 million litres of ethanol in 2008, with a total value of 225 million baht (US$ 6.4 million).[191]

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 in section 4, Thailand is actively engaged in developing a supportive regional framework for bioenergy. Whether or not 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 benefited from the higher food and fuel prices in 2007–2008.

[191] Information provided by Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, 2009. Bangkok.

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 opportunity 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 and 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 bioenergy sector will likely have a significant impact on Thailand's agricultural sector in the future. Thailand's competitiveness in agriculture is said to be based on cheap labour and an abundance of land resources, although the value of these strengths is debatable. The benefits of the agricultural sector are visible in terms of food self-sufficiency, poverty reduction, employment creation, and increasingly, feedstock inputs into the rapidly expanding bioenergy sector. The contribution of the agricultural sector to GDP (10 percent in 2007) and to exports (15 percent in 2007) has decreased significantly since the mid-1980s. Nevertheless, the contribution of agriculture to employment remains high, accounting for 40 percent in 2008 (World Bank 2008). Demand for energy crops has the potential to create employment and value added in this key sector of Thailand's economy. 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 have been identified and are addressed in subsequent sections of this case study.

Finding a balance between energy security, energy efficiency and sustainable resource management to develop the biofuels sector in a sustainable manner presents several challenges (see Box 1 on biofuel trade prospects in the Mekong region). It will require technological and productivity innovation alongside sustainable use of the natural resource base. Moreover, building a viable biofuels sector requires sustained political will to ensure effective implementation of policy mandates and enforcement of regulations.

Box 1: Prospects for trade in biofuels in the Mekong region

Opportunities	**Challenges**
To add value to agricultural production, efficiently manage waste agricultural residues	Well-defined bioenergy policies and targets at the national and regional level
To shift dependence from petroleum to enhance energy security in the emerging Mekong economies	Address food security concerns by balancing competing claims for land between food, fuel and fibre
To benefit from the Mekong's diversity of energy crops for ethanol and biodiesel	Economic incentives to deliver sufficient feedstocks; enhance awareness and information on the biofuels market
To develop small-scale bioenergy production, create resilience to external shocks, enable local energy sufficiency, stimulate rural development and reduce input costs from petroleum and fertilizers	Balance large-scale commercialized agro-industrial development of biofuels for the transport sector and for export
To benefit from low costs of production (land, labour, water)	Address land use changes and labour migration within the region resulting from biofuels development; need to ensure transparent, equitable investment and safeguard land rights
To create a potentially high demand as transportation infrastructure expands in a dynamic region	Enforce strategic impact assessments to address social and environmental consequences of biofuels plans and projects
To put the Clean Development Mechanism in operation, gain carbon credits and stimulate investment and technological innovation in second generation biofuels	Guide private sector investment through enforcing socio-environmental regulations (air, water, land and labour laws)
To develop the potential to export surplus biofuel production	Facilitate exports and secure market access (to meet sustainability criteria and address other non tariff barriers to biofuels trade)

2. LEGAL FRAMEWORK RELEVANT TO BIOENERGY

2.1 Institutional set-up of the energy sector

The energy sector in Thailand is administered by the Ministry of Energy, which was established in 2002 pursuant to the Restructuring of Government Organization Act (2002). The National Energy Policy Council, established under the National Energy Policy Council Act (1992), is responsible for managing the energy sector in Thailand, including granting energy operating licenses and issuing energy pricing regulations. Council members include ministers from all related sectors, 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 Council are the Energy Conservation Promotion Fund Committee (ECPFC), Energy Policy Committee (EPC) and National Energy Policy Office (NEPO).

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 programmes, 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.

2.2 Energy laws

The legal framework governing the energy sector is underpinned by the Energy Industry Act of 10 December 2007. The objectives of this Act include promoting an adequate and secure supply of energy and promoting the use of renewable energy that has less adverse impacts on the environment. The fundamental policy guidelines under the Act mandate the procurement of energy to adequately meet demand, with good quality as well as reasonable and fair prices. The guidelines also emphasize full exploitation and development of renewable energy and indigenous energy resources for the social, economic and environmental sustainable development of the country and to reduce dependency on imported energy. It also advocates the participation of local communities and the general public in the management

and monitoring of energy-related operations. The Energy Industry Act (section 51) gives the Energy Regulatory Board the authority to issue licenses for energy industry operation and to determine the criteria, procedures and conditions for energy industry operation, including those related to: efficiency of energy and resource utilization; requirements for the use of renewable energy and environmental standards. A Power Development Fund was established in section 93 of the Energy Industry Act in order to promote the use of renewable energy and technologies in the electricity sector.

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 discernible impact is that a flawed privatization process would have taken over the EGAT monopoly before establishing an independent regulatory authority. New attempts at privatization will likely be preceded by the establishment of a regulating authority, which should lessen the risk of EGAT's monopoly control of the transmission system.

The broad aims 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, its objective is to foster competition in the energy industry. For the first time, the document incorporates controversial plans to build four nuclear power plants each of 1 000 megawatts by 2021. The Plan also addresses energy conservation measures in the transport sector. With respect to renewable and alternative energy, the Plan has the following objectives to:

- sustain 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 organization 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; and

- promote private sector initiatives and public participation in energy policymaking.

The government has put several measures in place to meet the targets outlined in the Energy Policy and Development Plan. A Renewable Portfolio Standard regulating new power plants that must have 5 percent of their generation capacity derived from renewable energy (i.e. solar, wind, biogas etc). The government has also put incentives in place encouraging the purchase of power generated by renewable energy, including the provision of tax credits and privileges, and subsidies in the form of 'adders' for small power producers from the Energy Conservation Promotion Fund. Further, it has also promoted special investment privileges through the Board of Investment, such as 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) sets out targets for industry and transport, and equipment and appliance standards. These new targets stipulate in a Cabinet Resolution that the production of ethanol and biodiesel should reach 2.4 million litres and 3 million litres per day respectively by 2011. As of March 2009, the production of ethanol and biodiesel reached 1 million and 1.39 million litres respectively per day.[192] To promote a path towards renewable energy through wind, solar, biogas and biomass, the Ministry of Energy has mandated that 5 percent of electricity generated by new conventional power plants comes from renewable sources by 2011 (through a Cabinet Resolution in 2005). The 8 percent 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 generating 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 Box 2 below.

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[192] Information provided by Department of Alternative Energy Development and Efficiency (DEDE), Ministry of Energy, 2009. Bangkok.

The Ministry of Energy is revising the feed-in tariffs to ensure economic viability of these emerging sources of renewable energy.

2.3 Environment and natural resource laws

Thailand has several key environmental laws and regulations of relevance to bioenergy in place. These include the Enhancement and Conservation of National Environmental Quality Act (1992); Factory Act (1969, amended in 1992); Public Health Act (1992); Hazardous Substances Act (1992); Forest Act (1941); Community Forest Bill (2007); Land Code (1954); and the Land Reform for Agriculture Act (1975).

The Enhancement and Conservation of Natural Environmental Quality Act establishes general environmental principles that serve as the basis for all environment-related legislation and relevant national programmes. In this way, the environmental principles in the 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.

The Act sets up a National Environment Board to oversee coordination between ministries and guide conservation of national environmental quality (section 13). The law prescribes environmental quality standards and an environmental impact assessment process. It regulates aspects such as air and noise, water and other types of pollution and hazardous waste as well as the duty to use central waste treatment facilities based on the "polluter pays" principle. Interestingly, it establishes an Environmental Fund financed by the Fuel Oil Fund.

The Act contains a detailed environmental impact assessment (EIA) process, which incorporates public and expert participation in decision-making. 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. 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; and large industrial operations. However, it is pursuant to the National Environmental Quality Act, that the Ministry of Natural Resources and the Environment specifically 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: (i) location; (ii) standards on discharge of waste; (iii) documentation to ensure compliance with standards and requirements; and (iv) 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.

Several forest policies impact proposed expansion of energy crop plantations in Thailand. The forest policies are based on the following national plans and acts:

- 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 percent forested land was further divided into 25 percent for economic forests and 15 percent for conservation forests. Following the national ban on logging established in 1989, these targets were reversed to 25 percent for conservation forests and 15 percent for economic forests;

- The Tenth National Economic and Social Development Plan (2007–2011) ensures forests are maintained at no less than 33 percent, with no less than 18 percent for protected forests; and

- 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 percent Thai-owned are eligible to acquire land rights. There are however, exceptions with respect to the 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).

2.4 Investment laws

The investment legal framework also affects the development of bioenergy in Thailand. By way of the Investment Promotion Act (1977), and its subsequent amendments, Thailand's Board of Investment (BOI) under the Ministry of Industry assists in the formulation and implementation of investment promotion policies. The BOI 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 of 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-shop is provided by the Board of Investment to help investors with administrative procedures and to obtain the necessary permits, licenses and approvals. Alternative and renewable energy was added to the list of industries targeted by BOI for a proactive marketing campaign, which indicates the increasing importance of this sector.

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 law is relevant from the prospective of biofuels conversion from feedstock or related industries.

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 by-products derived from the production if they are exported; and

- exemption from or refund of taxes, if goods are taken into another export processing zone as if they have been exported[193].

The Foreign Business Act (1999) restricts foreign investment in 43 business sectors, including agriculture and forestry. In early 2007, the Ministry of

[193] BOI. 2008.

Commerce proposed amendments to the Foreign Business Act to increase restrictions on foreign investments, but these have yet to be approved.

2.5 International obligations

Thailand became a party to the General Agreement on Tariffs and Trade (GATT) in 1982 and a member of the World Trade Organization (WTO) in 1995. It is also a member of multilateral environmental agreements relevant to bioenergy: the United Nations Framework Convention on Climate Change (UNFCCC) which was ratified by a Cabinet Resolution on 28 December 1994 and entered into force on 28 March 1995; the Kyoto Protocol (ratified on 28 August 2002); and the Convention on Biological Diversity (ratified on 31 October 2003).

Agricultural trade liberalisation is a critical component of the Doha Round of Negotiations in the WTO. First, commodity-exporting developing countries in particular would benefit from greater market access for agricultural products (energy crops). Second, as a major agricultural exporter, Thailand would gain from agricultural trade liberalization efforts towards the removal of 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,[194] 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.

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 adaptation; and policies, measures and other aspects related to financial resources, technology transfer and capacity building.[195]

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 be placed 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 will invariably impact the legislative and policy framework for bioenergy. Climate change has slowly emerged as a

[194] Brazil. 1998.
[195] MOSTE. 2000.

driver for the development of bioenergy policies in Thailand. However, the introduction of a five-year National Strategy on Climate Change in early 2008 paved the way for Thailand's active engagement in this area, particularly through the Clean Development Mechanism (CDM) of the Kyoto Protocol.

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.[196]

2.5.1 Clean Development Mechanism

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

Thailand is an active host for CDM projects. The newly created Thailand Greenhouse Gas Management Organization (TGO) acts as the Designated National Authority and has adopted national guidelines for approving CDM projects. As of April 2009, the TGO has approved 60 CDM projects in Thailand.[197] 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-shop for CDM applicants. 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.

The use of alternative energy is an economic indicator for Thailand's Sustainable Development Criteria for CDM project evaluation. A point

[196] ONEP. 2006.
[197] Thailand Greenhouse Gas Management Organization. 2009.

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 the government, 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 Box 3.

Box 3: 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 organized)
- 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
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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: Thailand Greenhouse Gas Management Organization (TGO) 2009. Information available at www.tgo.or.th

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 these two sectors. Phase 2 focuses on establishing procedures and criteria for other sectors.

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

- 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);
- energy efficiency (e.g. projects to increase efficiency of combustion and steam generation, cooling systems or energy use in buildings);
- environment (projects to convert waste into energy or biofertilizers);
- transport efficiency; and
- industrial processes (projects that lead to reduced GHGs).

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 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. As yet, CDM projects do not encompass afforestation and reforestation, although the Ministry of Natural Resources and the Environment is studying the feasibility of including criteria for afforestation and reforestation in CDM projects.

It should be noted that 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 limited environmental impacts. However, the Ministry of Energy can still request the preparation of an environmental impact assessment.

3. BIOENERGY POLICIES AND LEGAL FRAMEWORK

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 feedstock for biofuels. Thailand's energy intensity in relation to gross domestic product (GDP) has been rising since the early 1980s to a relatively high ratio of 1.4: 1, meaning that for each percent increase in GDP, there is a resulting increase of 1.4 percent in energy consumption. The majority of energy is consumed in the transport (37 percent) and industrial (36 percent) sectors.

Thailand's biofuels sector is comparatively more advanced than in other countries in Asia for several reasons. First, Thailand has been seeking to change its heavy dependence on imports of petroleum to stimulate its export-led growth. Over the past decade, Thailand spent approximately 10 percent of its annual GDP on oil imports. In light of the volatile world price of oil, biofuels offer a means to diversify fuel sources, thereby increasing energy security. In the 1980s, Thailand began investing in research

and development to decrease oil dependence by converting its abundant agricultural biomass into biofuels.[198] In addition, developing the biofuels sector provides an opportunity to add value to the agricultural sector and stimulate 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. It also 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 percent of national energy consumption with renewable energy by 2022, compared with 8 percent in 2008. With its abundant agricultural resources, Thailand's objective is to increase its energy security by 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: ethanol; biodiesel; and biogas and biomass-to-liquid (BTL).

3.1 Alternative Energy Development Plan

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 of 15.6 billion baht (US$ 450 million) to develop renewable energy over the next fifteen years. The goal of the Alternative Energy Development Plan is "to increase the share of the alternative energy mix to be 20 percent of the country's final energy demand by 2022." The Plan has the following general objectives, to: increase the contribution of alternative energy in order to replace oil imports; increase energy security; promote integrated green energy utilization in communities; enhance the development of alternative energy technology industries; and research, develop and encourage high efficiency alternative energy technologies.

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 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.

[198] JGSEE. 2009.

According to the Department of Alternative Energy Development and Efficiency (DEDE), in 2008 Thailand exported approximately 71 million litres of ethanol to a range of countries, including Australia, Japan, the Netherlands, the Philippines, Singapore and Taiwan. Exports are hampered, however, by the need for case-by-case approval by 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 4 baht/litre lower than regular gasoline. A new Gasohol 95 with a higher proportion of ethanol mix (20 percent) 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 shall contain at least 2 percent biodiesel (B2). The Energy Policy and Planning Office indicates that as of 1 February 2008, B2 is the standard biodiesel mix sold nationwide. Thailand also produces a large quantity of biofuel originating 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 Energy Conservation Promotion Fund is supporting research on the feasibility of biogas generation from landfill and industrial wastewater.

The Alternative Energy Development Plan will be implemented in three phases. The short-term (2008–2011) focus will be on promoting proven technologies for alternative energy with high potential, such as biofuels and power and heat generation from biomass and biogas. The medium term (2012–2016) objectives are to focus on alternative energy technology industry and supporting the development of new prototypes of alternative energy technologies for higher cost-effectiveness; and promoting new technologies for biofuel production and development of Green City prototypes that lead to strengthened local alternative energy production. The final phase of the Plan (2017–2022) will entail the promotion of new technologies for alternative energy that are cost-effective, such as hydrogen energy, extending Green City and local energy. By this time, the Plan foresees Thailand as becoming a regional hub within the Association of South-East Asian Nations (ASEAN) for biofuel and alternative energy technologies. The Department of Alternative Energy Development and Efficiency outlines the following activities corresponding to the three phases:

Phase 1: 2008–2011

- research 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; and
- establish investment incentives under the Board of Investment**.**

Phase 2: 2012–2016

- 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; and
- develop Thailand as a biofuel hub and exporting centre.

Phase 3: 2017–2022

- 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; and
- implement tax measures to stimulate the biofuels industry.

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.

3.2 Ethanol

Thailand's gasohol production programme began in 1985 when the present reigning monarch, His Majesty King Bhumiphol Adulyadej, initiated a gasohol development project at Chitratlada 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: two main crops used in ethanol production. While cassava is a promising future feedstock for the ethanol industry, the current main feedstock for ethanol is a by-product of sugar production – molasses. As of May 2009, Thailand's existing capacity for ethanol production (from molasses, sugarcane, starch and cellulose) is 1 million litres per day with a projected ethanol capacity of 3.3 million litres per day.

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. Recent information from the Department of Alternative Energy Development and Efficiency indicates that as of April 2009, over 4 166 service stations nation-wide sell gasohol.

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 liberalization 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 comprising the Ministries of Energy, Industry, and Agriculture and Cooperatives was also created in order to determine measures to promote the construction of ethanol production plants and to develop plans for raw materials (feedstock) management. The Plan, approved by the National Biofuels Committee on 16 May 2007, consists of the following key elements:

- increasing ethanol production to 2.4 million litres per day by 2011 and 9 million litres per day by 2022;
- phasing-out methyl tertiary-butyl ether (MTBE) in unleaded gasoline;
- developing specifications for Gasohol 95 (91 octane gasoline mixed with 10 percent ethanol);
- ensuring that Gasohol 95 and 91 are available nation-wide;
- requiring by law that all petrol consumed will be Gasohol 95 by 2012; and
- carrying out research and development into vehicle performance as well as monitoring gasohol emissions.

Since 1979, the Ministry of Agriculture and Cooperatives has supported research to improve the processing of sugarcane to alcohol and, subsequently, to enhance the processing of cassava.[199] The Strategic Cassava Plan (2002–2006) focused on ensuring sufficient supply for industrial use without expanding cultivated areas. Thailand is investing in research to 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 estimates that there is a significant potential to increase domestic capacity of tapioca for export. Box 4 summarizes the main resolutions by the National Energy Policy and the Cabinet relating to ethanol.

Box 4: Resolutions pertaining to ethanol

Approving body and date	**Summary of resolution**
National Energy Policy Council (26 April 2002)	Outlines methods of promoting ethanol use as fuel.
National Energy Policy Council (12 September 2002)	Resolves that 0.036 baht per litre from gasohol sales goes into the Energy Conservation Promotion Fund.
National Energy Policy Council (28 July 2004)	Permits the licensing of factories producing and selling ethanol as fuel.
Cabinet (17 May 2005)	Targets set to distribute Gasohol 95 nationwide and employ measures to increase ethanol consumption.
National Energy Policy Council (22 December 2006)	Targets EURO 4 as emission standard by 2012.

[199] Pitisant, K. 2007.

Committee on Energy Policy Administration (5 February 2007)	Sets the price of Gasohol 91 to be less that unleaded gasoline 91 by 1.50 baht per litre.
National Committee on Biofuel Development and Promotion (16 May 2007)	Gasohol Strategic Plan approved to promote ethanol blending in gasoline at 10 percent and 20 percent up to 2.4 million litres a day by 2011.
Ministry of Energy (15 December 2007)	Sets the price of E20 lower than Gasohol 95 E10 by 2 baht per litre and lower than Benzene 95 by 6 baht per litre.

3.2.1 Government incentives for ethanol production and use

The price mechanism is the primary method by which the government promotes gasohol; the sale price of ethanol is set by the government. 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. 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) per litre; the price gap between Gasohol 91 and unleaded gasoline is 3.50 baht (US$ 1) per litre.[200]

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

3.2.2 Board of Investment's promotion of ethanol

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

[200] Energy Policy and Planning Office figures for 2009.

required machinery be imported from the investor's countries of origin. Hence the import duty benefits offered by the Board of Investment);

- eight-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 percent 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);[201]

- expanded land ownership rights for foreign investors beyond the provisions in the Land Code (1954);

- permission to bring in foreign experts and technicians; and

- work permits and visa facilitation.

The Board of Investment currently supports nearly 30 ethanol projects situated throughout Thailand that have a combined capacity of nearly 6 million litres per day. In 2008, there were several projects that sought promotional privileges from the Board of Investment to develop ethanol from cassava in the Northeast of Thailand. Five BOI-approved cassava-based ethanol projects, amounting to 16.5 billion baht (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 percent since 2005, and is predicted to continue to grow to provide ethanol feedstocks.

In December 2008, the Board of Investment approved ten large-scale projects to stimulate development (including an ethanol production project) producing 200 000 million litres per day from molasses sugarcane. Eighty percent of this amount shall be sold to domestic energy companies.

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[201] WTO. 2007.

3.2.3 Automotive sector

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, although the Association of Southeast Asian Nations' (ASEAN) region is an increasingly major market. After electronic and electrical components, the automotive industry accounted for the second highest contribution to export revenue in 2005 in Thailand; between 2002 and 2005, exports of motor vehicles and motorcycles grew by an average of 35.31 percent.[202] The auto industry is a key driver of Thailand's two-fold increase in investments to 644.5 billion baht in 2007 (US$ 1.8 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. FFVs are vehicles designed to use fuel blended up to 85 percent ethanol. Several major car-manufacturing companies are expected to produce FFVs in Thailand, and some have introduced E20 car models in Thailand.

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 percent up to a ceiling rate of 50 percent for cars fuelled by ethanol blended with gasoline, at not less than 20 percent. To benefit from these rates, cars fuelled by E20 gasohol need to complete three performance requirements. First, the engine must be designed for at least 20 percent ethanol; second, a warrantee from the manufacturer for an engine fuelled by 20 percent ethanol is mandatory; and finally, the car must meet the Pollution Standard Accreditation from the Thailand Industrial Standard Institute (TISI) at not lower than TISI 2160-2546.

3.2.4 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

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[202] WTO. 2007.

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 although export of Thai-produced ethanol for energy purposes to foreign consumers is currently prohibited. Given excess domestic supply, in 2008 approximately 71 million litres 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 in 2009 according to the Department of Alternative Energy Development and Efficiency.

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 Organization calculated this support to be equivalent to approximately 1 percent of GDP and over 6 percent of total government expenditure.[203] The sustainability of the entire chain of production of agro-fuels will affect trade and have development implications, particularly for developing countries. Compliance with the sustainability criteria of the European Union 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.

3.2.5 Summary

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

- The government intends to replace 10 percent of all gasoline with gasohol and increase the use of ethanol from 2.4 million litres per day by 2011 to 9 million litres per day by 2021.

- A new Gasohol 95 (E20) has recently been introduced. This E20 blend contains 20 percent ethanol as opposed to the more common E10 blend with 10 percent ethanol. Generally, automobiles do not need any engine alterations to switch from regular gasoline to gasohol as long as

[203] WTO. 2007.

the ethanol content of the gasohol does not exceed 10 percent. However, car manufacturers have recently released car models with engines that tolerate a 20 percent gasohol mix.

- Gasohol 95 (E10) is priced at 1.5 baht lower per litre than unleaded gasoline (ULG), with the E20 blend being priced at 3 baht cheaper per litre.

- The number of gas stations selling gasohol nation-wide is 4 166.

- The government licensed 47 ethanol plants, with 12 ethanol plants in operation.

- The government has recognized several crucial problems facing the ethanol industry:
  (i) need for greater coordination between different government ministries and departments involved in the ethanol industry;
  (ii) an excess of supply leading to intermittent ethanol production suspensions; and
  (iii) a domestic price of ethanol that is currently lower than the production cost.

- The government resolved these issues by taking the following measures:
  (i) creating a joint committee with representatives from related ministries;
  (ii) increasing gasohol distribution nationwide to stimulate demand; and
  (iii) promoting ethanol production, including for export.

3.3 Biodiesel

With the mandatory use of B2 diesel nationwide as of February 2008, the biodiesel industry in Thailand is poised for rapid growth. The main feedstock for biodiesel in Thailand is palm oil, with increasing production of jatropha. Thailand's geographical position offers conducive climate and soil conditions for palm oil growth and production. Notwithstanding the steady increase of palm oil production in Thailand since 1995, the government's target to produce 3.3 million litres per day by 2012 is ambitious considering the existing figure of 1.39 million litres per day.

The Biodiesel Development and Promotion Strategy outlined in 2005 consists of the following key elements:

- increase biodiesel production to 3 million litres per day by 2012;
- substitute 5 percent of all diesel consumption with biodiesel by 2012;
- in order to ensure the nationwide distribution of B10 by 2012, adopt a two-stage policy to introduce B5 (5 percent biodiesel mix) in Bangkok and southern Thailand in 2008 and extend the availability of B5 to all regions of the country by 2011; and
- increase to 5 percent biodiesel (B5 blend) in 2012 the current 2 percent biodiesel (B2 blend) that was imposed in February 2008.

In order 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 tonnes per hectare to 22 tonnes, as well as to increase the crushing rate of crude palm oil from 17 percent to 18.5 percent by 2012. The Ministry of Agriculture has calculated that in order to facilitate expansion of palm oil production, an additional 5 million *rai* (800 000 hectares) of land is needed for palm oil cultivation. The Department of Alternative Energy Development and Efficiency indicates plans are in place 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. It is worth highlighting at this juncture that environmental considerations are imperative in target-setting to ensure that palm oil plantations do not come at a high environmental cost. Thailand has increasingly been subjected to criticism on account of plans to expand palm oil plantations which do not consider environmental or social sustainability.

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 tonnes 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.

Box 5 below summarizes the main resolutions by the National Energy Policy and the Cabinet relating to biodiesel.

Box 5: Resolutions pertaining to biodiesel

Approving body and date	**Summary of resolution**
Cabinet (26 November 2005)	Ministry of Agriculture shall: - complete the zoning of palm planting areas within 6 months; - establish the biodiesel purchasing price/litre as an incentive for producers (with the government to pay the difference between the actual price of diesel and purchasing price).
Committee on Energy Policy Administration (5 February 2007)	Sets the price of biodiesel B5 to be less than diesel by 1 baht/litre.
National Energy Policy Council (2 April 2007)	B5 biodiesel price fixed at 0.70 baht/litre lower than diesel.
National Energy Policy Council (9 April 2007)	Mandates the comprehensive usage of B2 by 1 February 2008

3.3.1 Government incentives for biodiesel production

The Ministry of Energy and the Bank for Agriculture and Agricultural Cooperatives have allocated a budget of 7 billion baht (US$ 204 million) to provide loans for farmers to invest in palm oil production. Another 1.2 billion baht (US$ 34 million) has been set aside by the Ministry of Energy to provide loans to commercial-scale biodiesel plants.

3.3.2 Research and development

According to the Energy Policy and Planning Office, the Ministry of Energy has undertaken research and development on various aspects of biodiesel together with other ministries. Research initiatives include the production and utilization of biodiesel from oil plants and animal fat and the design and installation of pilot community-based biodiesel plants. Furthermore, the Ministry has supported 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.

The Ministry has also engaged in studies to promote biodiesel in the transport sector, while the Ministry of Agriculture and Cooperatives is also undertaking research to increase palm oil productivity.

3.3.3 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 plan seeks to reduce local communities' expenses on energy by producing and using biodiesel from used cooking oil or other oil plants grown in the community to replace diesel use.[204] It also promotes community self-reliance for energy supply and enhances the sense of community unity through the establishment of cooperatives for biodiesel production and distribution. This scheme is designed to create pilot or prototype communities for further dissemination of community-based biodiesel production and utilization schemes. The second phase of the plan expands the coverage to 400 communities, with an additional 155 million baht (US$ 4.3 million) to purchase oil pressing and processing machines.

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 used as the feedstock for these community biodiesel projects. Extensively used as biodiesel feedstock in India, jatropha grows easily on marginal lands and does not necessarily compete with food crops. The benefits of using jatropha are contingent on the availability of marginal land and the degree to which yield of oil content can be enhanced. Critics note that neither of these aspects can be easily met in Thailand; more work is needed to increase oil content and to identify appropriate land for jatropha cultivation.[205] Although 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.

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[204] Samai, J. and Wanun, P. 2007.
[205] Ibid.

3.3.4 Trade-related considerations

In January 2008, given the 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 as an exceptional measure, 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 Organization, Thailand has a tariff-rate quota regime for palm oil imports. 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.[206]

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 (for example, those requiring non-automatic licensing), imports 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.

3.3.5 Summary

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

- The current stocks of pure biodiesel (B100) within the country do not 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 tonnes 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;.

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[206] WTO. 2007.

- The government recognizes several problems concerning biodiesel promotion, production and use, such as:
  (i) increase in the price of crude palm oil;
  (ii) lack of sufficient supply of crude palm oil to meet biodiesel production targets; and
  (iii) 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 related to biodiesel production:
  (i) 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;
  (ii) 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; and
  (iii) 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.

3.4 Biogas, biomass-to-liquid (BTL) 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 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 detrimental environmental impact – around 21 times that of carbon dioxide. At the forefront of innovative biogas projects are those from palm oil refineries, tapioca mill wastewater and rice husks through to innovative projects for elephant dung. The Ministry of Energy estimates that actual production of biogas for heat generation has reached 79 ktoe and 13 ktoe for electricity. There is a huge potential to expand biogas production, as well as reduce methane gas emissions contributing to climate change.

The Energy Conservation Promotion Fund described above dedicated approximately US$ 33 million between 1995–2004 on research and development of biogas generation from wastewater treatment systems in industrial factories. 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.

The biogas sector benefits from measures to increase the purchase of electricity 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 percent of power generated from new power plants to be generated from renewable energy. In addition, a power purchase programme was established for Small Power Producers in 1992. A budget of over 3 billion baht (US$ 86 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. A programme for "very small renewable energy power producers" was put in place in 2002.

Pursuant to the Enhancement and Conservation of National Environmental Quality Act, 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 Organization under the Clean

Development Mechanism 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.

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, wastewater from livestock farms and municipal solid waste. It is estimated that over 600 million tonnes 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 pollution created by livestock farming. 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.[207]

As a country with abundant agricultural resources, Thailand is well positioned to utilize the residues generated from agro-industrial production as an energy source. Biomass power plants generate electricity from production processes or agricultural wastes 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 Board of Investment approved a 1.9 billion baht (US$ 54 million) investment by the Global Biodiesel Company to convert organic waste into energy. The private sector in Thailand is taking the lead in developing technologies to generate power from biogas from waste material.

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[207] EPPO. 2007.

Thailand is a leading sugarcane producer and the second largest global exporter of sugar. The by-products 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 utilized in Thailand for steam and power production in domestic sugar mills, with the surplus bagasse used in cogeneration electricity production to feed into the commercial 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.

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 manage waste cheaply by leaving it unprocessed in open tanks. The majority of the existing 77 cassava processing plants already have or are in the process of acquiring biogas technology as a more cost effective alternative to processing wastewater.[208]

4. REGIONAL ENERGY FRAMEWORK

A driving force stimulating development in the bioenergy sector in Thailand is the intensifying regional cooperation underway with its neighbours. 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.

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

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[208] EPPO. 2007.

As outlined above, 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 the desire to find a substitute for imported petroleum. In contrast to Malaysia and Indonesia, Thailand has yet to develop exports of biofuels to any significant extent even though 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.

4.1 Association of Southeast Asian Nations

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

Bioenergy issues were addressed for the first time at the 26th ASEAN Ministers on Energy Meeting in Bangkok on 7 August 2008. With respect to expanding external energy cooperation, ministers noted the solid progress in fostering 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 recognized as an alternative to reduce ASEAN's fossil fuel consumption. Ministers emphasized 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".[209] Biofuels is also being addressed in the context of ASEAN cooperation to respond to the impacts of climate change, including a new

[209] ASEAN-AMEM. 2008.

initiative on "ASEAN Strategy in Addressing the Impact of Climate Change on Agriculture, Fisheries and Forestry".[210]

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

1) adopt the ASEAN Integrated Food Security Framework and the Strategic Plan of Action on Food Security in the ASEAN Region (2009–2013) to be implemented by ASEAN Ministers on Agriculture and Forestry;
2) support development of agricultural productivity through greater investment, improved research and development, enhanced agricultural innovation and knowledge management, and strengthened farmers' organizations;
3) consider the development of biofuels through science and technology advancement that does not have adverse impacts on 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. This work will be reviewed by Senior Officials Meeting of the ASEAN Ministers on Agriculture and Forestry and in the context of the *Ad Hoc* ASEAN Task Force on Task Force on Food Security established in 2008.

4.2 Asia-Pacific Economic Cooperation

The Asia-Pacific Economic Cooperation (APEC) was launched in 1989 to liberalize trade and boost investment among its 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 APEC Energy Working Group has facilitated member economies to understand the potential for biofuels to replace petroleum in the transportation sector. The Working Group is in the process of establishing standards for ethanol and biodiesel. APEC has also set up demonstration

[210] Ibid.

projects to encourage second-generation biofuels.[211] 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.[212]

4.3 Greater Mekong subregion

Thailand is an active participant in increasing subregional integration, with implications for the development of biofuels. The first Greater Mekong Subregion (GMS) Summit in 2002 endorsed a Strategic Framework of the GMS, focused on achieving connectivity, competitiveness and community. The GMS members are Cambodia, China (Yunnan Province and Guangxi Autonomous Region), Lao PDR, Myanmar, Thailand and Vietnam. 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. This is part of a larger GMS integration framework initiated by the Asian Development Bank's economic corridors initiative in 1992.[213] With an emphasis on infrastructure development and promotion of a free 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 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. The programme targets smallholder farmers and the rural poor in the GMS in order to foster cross border 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 ADB is also

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[211] APEC, 2008(a).
[212] APEC, 2008(b).
[213] ADB, 2008.

examining the feasibility of using biofuels in the transport sector in the Mekong region.[214]

4.4 Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy

Established in November 2003, the Ayeyawady-Chao Phraya Mekong Economic Cooperation Strategy (ACMECS) includes Cambodia, Lao PDR, Myanmar, Thailand and Vietnam and "acts as a building block and moves ASEAN forward at a more even pace, on the basis of self-reliance and mutual prosperity". The objectives of this economic cooperation framework are to bridge the economic gap among the five countries and to promote prosperity on a sustainable basis. The framework seeks to build partnerships to transform the border areas of the five members into zones of economic growth and social progress, and to 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 under-utilized. Certain agricultural areas are not conducive to farming of cash crops. Therefore, the farming of oil crops, such as jatropha represents a viable alternative source of biodiesel for local use. This would reduce farmers' expenses and dependence on oil imports and potentially lead to energy self-sufficiency in a sustainable manner. Given its advanced capacity for biofuel production, 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 oil and biodiesel production, financing pressing and biodiesel processing machines, as well as conducting training and information sharing on farming oil crops in local communities.[215]

Thailand provides "One Way Free Trade" with Cambodia, Lao PDR, Myanmar and Vietnam, which entails the application of a 0 to 5 percent tariff

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[214] Samai, J. 2009.
[215] ACMECS. 2008.

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).[216] Thailand also provides technical assistance to promote market incentives for contract farming and increased agricultural productivity, which has the likely effect of expanding areas for cultivating bioenergy crops.[217] 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 perceived 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.

4.5 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 to create a free trade agreement between the countries. The Thailand Development Research Institute finalized a study on the potential impacts and opportunities of JTEPA for the Thai economy.[218] The results indicated the potential for Thailand to benefit from energy cooperation.

Bioenergy issues have not been explicitly addressed under the JTEPA framework. 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 this end. In this context, Thailand and Japan have agreed to discuss technology transfer related to bioenergy.

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[216] BOI Bulletin. 2009.
[217] ACMECS. 2008.
[218] TDRI. 2006.

4.6 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 will reduce transportation costs and increase the Triangle's competitiveness.[219]

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 efforts to address food security, volatility of energy prices and climate change.[220]

4.7 Future prospects

Increased regional cooperation has stimulated trade and investment in bioenergy in Asia, particularly in the Mekong region, but scant emphasis is placed on socio-environmental considerations. Greater attention to the social and environmental sustainability of bioenergy generation and use should therefore be paid. Providing legal clarity and consistency of implementation for trade and investment in bioenergy should also address mounting concerns about food and fuel competition for agricultural land, as well as biodiversity and forest conservation related to the expansion of agro-industrial energy crops. Policy makers need to provide a stable and predictable framework to stimulate investment in bioenergy development in the region, while ensuring environmental and social sustainability.

5. CONCLUSIONS: OPPORTUNITIES AND CHALLENGES

Bioenergy is not new to Thailand. The King's Royal Chitralada Projects initiated in the 1980s 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

[219] For more information see www.adb.org.
[220] ASEAN. 2009.

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.

Thailand is supporting biofuel production and use to contribute to diversifying the fuel mix in the transport sector, including measures mandating the use of biodiesel, providing tax incentives for biofuel producers and automobile manufacturers, as well as low interest loans to palm oil producers. Thailand has commercialized gasohol and biodiesel. Gasohol already accounts for nearly 60 percent 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 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 subsidize 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 unintended implications for sustainable development. It may lead to increased food prices and encourage farmers to expand agriculture in environmentally fragile areas. There is thus a continuous need for Thailand to monitor and assess the implementation of its bioenergy policies and regulations. Thailand recognizes 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 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 an international dimension. This entails that a switch from food to fuel cultivation can potentially impact upon food security in the Thailand, but also affect 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 seen in this case study, while there is insufficient palm oil to meet the domestic demand, exports of ethanol began in 2007.

While perhaps better 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 recognized sustainability criteria would also better enable Thailand to trade in biofuels in the future. As highlighted above, regional frameworks need to place greater emphasis on establishing and implementing quality standards and sustainability criteria in the bioenergy sector.

There are several observations to be made regarding the emerging national legal 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. The government is engaging with the private sector to put in place national roadmaps for ethanol, biodiesel and biogas. Such emphasis will likely assist in developing the legal and policy structure based on a deeper understanding of the impacts of various alternative energy options.

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 links between agriculture, land use, forestry and environmental

policies to implement national targets for biofuels. Thailand needs to continue to work towards greater policy integration between different government ministries that deal with the various aspects of bioenergy policies and regulations. Recognizing the need for strengthening policy coordination between the various ministries involved in bioenergy decision-making, a new National Biofuels Organization is expected to be formed. This would buttress 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 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 Greater Mekong Sub 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 recognizes 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 Organization can approve project proposals.

The TGO has also moved quickly to establish procedures and sustainability criteria for guiding CDM projects. 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 has called for an increased use of biodiesel, gasohol and other alternative energy sources to reduce oil imports, which cost the country over 10 percent 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 subsidized by the government. To support these goals and targets for bioenergy, Thailand needs to develop implementing legislation for the acts and plans discussed in this study. Secondly, 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 including diversion of land use away from food and giving up biodiversity-rich areas in favour of energy crops. Finally, there are two tracks for biofuel development in Thailand signalled by the recently finalised standards for commercial and community use. The potential is to increase energy sufficiency and resilience at the community-level, while adding value and reducing inputs to agricultural production for commercialised biofuels. However, the difficulty is to distinguish between the two in the regulatory system.

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