

1. Project Data

Summary project data			
GEF project ID		4037	
GEF Agency project ID		100264	
GEF Replenishment Phase		GEF - 4	
Lead GEF Agency (include all for joint projects)		United Nations Industrial Development Organization (UNIDO)	
Project name		Overcoming policy, market and technological barriers to support technical innovation and south-south technology transfer: The pilot case of ethanol production from cassava	
Country/Countries		Thailand, Viet Nam, Myanmar, Laos	
Region		Asia and the Pacific	
Focal area		Climate Change	
Operational Program or Strategic Priorities/Objectives		SP4: Promoting sustainable energy production from biomass	
Executing agencies involved		King Mongkut's University of Technology Thonburi (KMUTT), Thailand; Liquor Distillery Organization (LDO), Thailand; Ministry of Industry and Trade (MOIT); Viet Nam, Food Industries Research Institute (FIRI), Viet Nam	
NGOs/CBOs involvement		none	
Private sector involvement		Kaung Kyaw Say Group of Companies (KKS), Myanmar	
CEO Endorsement (FSP) / Approval date (MSP)		March 2012	
Effectiveness date / project start		June 2012	
Expected date of project completion (at start)		January 2016	
Actual date of project completion		December 2018	
Project Financing ¹			
		At Endorsement (US \$M)	At Completion (US \$M)
Project Preparation Grant	GEF funding	0.1	0.1
	Co-financing	0.08	0.08
GEF Project Grant		2.6	2.6
Co-financing	IA own	0.19	0.19
	Government	6.4	6.4
	Other multi- /bi-laterals		
	Private sector	25	25
	NGOs/CSOs		
Total GEF funding		2.7	2.7
Total Co-financing		31.7	31.7
Total project funding (GEF grant(s) + co-financing)		34.4	34.4
Terminal evaluation/review information			
TE completion date		July 2019	
Author of TE		Dr. Alfredo Curbelo Alonso and Ms. Sopin Wachirapuwadon	
TER completion date		28 January 2020	

¹ TE, p76

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2. Summary of Project Ratings

Criteria	Final PIR	IA Terminal Evaluation	IA Evaluation Office Review	GEF IEO Review
Project Outcomes		S	-	S
Sustainability of Outcomes		"Very likely"	-	ML
M&E Design		S	-	MS
M&E Implementation		S	-	S
Quality of Implementation		S	-	HS
Quality of Execution		S	-	S
Quality of the Terminal Evaluation Report		--	-	S

3. Project Objectives

3.1 Global Environmental Objectives of the project:

The goal and environmental objective of the project is to "reduce GHG (greenhouse gas) emissions in the ethanol production sector, as well as to increase use of ethanol for fuel in Thailand and LMV (Laos, Myanmar, Viet Nam) countries." (TE, p11).

In other words, the project aims to significantly reduce imports of petroleum-based products, such as gasoline, in countries of the LMV region by replacing them with ethanol produced from cassava on a sustainable basis.

3.2 Development Objectives of the project:

The development objective of the project is "to remove barriers and create a conducive environment to promote the adoption of ethanol production technology from cassava and South-South technology transfer" (TE, p8). The project aims to foster technical innovation and South-South technology transfer from Thailand to neighboring countries.

The project activity is the technology transfer of Very High Gravity-Simultaneous Saccharification and Fermentation (VHG-SSF) technology developed by NSTDA, Thailand to LMV countries. Under the project, two pilot scale ethanol production plants, one each at Thailand (200 l/d) and Vietnam (50 l/d) respectively, will be implemented. The project will also facilitate the establishment of one commercial scale ethanol production plant project of 400,000 l/d in Myanmar. In addition, an ethanol information hub at NSTDA, Thailand and a technical centre at FIRI, Vietnam will be established. Efforts will be taken to popularise the use and production of bio-ethanol by creating the necessary awareness and trainings, policy and investment forums, project development assistance, etc.

The Very High Density – Simultaneous Saccharification and Fermentation (VHD – SSF) technology, developed by King Mongkut's University of Technology Thonburi (KMUTT) in Thailand, is the technology to be transferred. This technology allows the use of fresh cassava roots as raw material for bioethanol production, reduces energy consumption and production costs and increases production capacity of existing bioethanol production facilities.

3.3 Were there any **changes** in the Global Environmental Objectives, Development Objectives, or other activities during implementation?

This project supports a South-South technology transfer process in the Southeast Asia region. The technology transferor country is Thailand, while transferee countries initially were Myanmar, Viet Nam and potentially Lao PDR. However, at the beginning of project implementation, due to a change of government and energy policy in Myanmar in late 2011, country development priorities changed, biofuel promotion ceased to be a national priority and this country quit the project. Myanmar's Framework for Economic and Social Reforms (FESR) for 2012-2015 did not include Biofuels development as a target nor as a prioritized item. Consequently, the private investor that was supporting investment in ethanol from cassava in Myanmar formally quit the project. The alternative to keep this technology transfer output in place was proposed by Laos, which had initially planned to attend only capacity building activities. In April 2015, the Institute for Renewable Energy Promotion (IREP) in Laos sent UNIDO a letter of interest to collaborate on the project with two Laotian companies to adopt the technology for ethanol production of a total of 200,000 liters per day. The main beneficiaries of this project would be governmental departments in charge of biofuel policy, private companies, and R&D and financial sector institutions. Laos thus became an active partner and recipient of the technology transfer process, and effectively replaced Myanmar as a recipient country of the project's technology transfer component (TE, p9).

4. GEF IEO assessment of Outcomes and Sustainability

Please refer to the GEF Terminal Evaluation Review Guidelines for detail on the criteria for ratings.

Relevance can receive either a Satisfactory or Unsatisfactory rating. For Effectiveness and Cost efficiency, a six point rating scale is used (Highly Satisfactory to Highly Unsatisfactory), or Unable to Assess. Sustainability ratings are assessed on a four-point scale: Likely=no or negligible risk; Moderately Likely=low risk; Moderately Unlikely=substantial risks; Unlikely=high risk. In assessing a Sustainability rating please note if, and to what degree, sustainability of project outcomes is threatened by financial, sociopolitical, institutional/governance, or environmental factors.

Please justify ratings in the space below each box.

4.1 Relevance	Rating: Satisfactory
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The TE rates the relevance of this project as ‘highly satisfactory’. This TER rates relevance as satisfactory, as the use of bioethanol to reduce / replace gasoline consumption is recognized as economically impactful and a national priority in national development strategies of participating countries.

The participating countries indeed have “biofuel development strategies that set specific targets for bioethanol use” but have actually witnessed important increases in fuel consumption during the project implementation period (2012-2018) as a result of fast economic growth, thus relying ever more on costly fuel imports. The project is therefore relevant as it helps participant countries achieve their development goals through the reduction of fuel imports and the replacement of gasoline by bioethanol mixes.

The project is consistent with the GEF Climate Change focal area strategic program SP4 under the GEF-4 replenishment phase: promoting sustainable energy production from biomass, whose long-term objective is to support new low-GHG emitting and cost-effective energy technologies. The GEF’s climate change focal area strategy and strategic programming document for GEF-4 states that “Support may be given to investigate the suitability and sustainability of producing biofuels to substitute for petroleum fuels used” (GEF-4 Climate Change Mitigation Strategy Document, p11).

The project is also in line with UNIDO’s mandate to “build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation” and with one of its four strategic priorities, “safeguarding the environment”, under which “the provision of sustainable energy” is a goal.

4.2 Effectiveness	Rating: Moderately Satisfactory
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The TE rates the effectiveness of this project as ‘satisfactory’, and this TER rates effectiveness as moderately satisfactory, as most, but not all, of the outputs focused on removing barriers for technology transfer were achieved.

Most of the project outputs, such as the enhanced capacity of the technology transferor to lend sustainable support to the region and the improvement of pricing practices and policies, were achieved. Outputs not showing progress nor completion, such as private sector involvement and the commercialization of bio-ethanol production technology, are related to project design failures. These outputs are focused on processes for implementing commercial projects by private companies for bioethanol production from cassava and were designed in such a way that they could not be achieved within the scope of the project implementation. Likewise, some of the project partners were unable to deliver outputs as planned.

A summary of the project’s achievements, by component, is provided below (TE, Table 7, p35):

- Component 1: Institutional capacity strengthening for VHGSF technology dissemination

The project mostly succeeded in consolidating a consortium of Thai institutions, led by KMUTT (King Mongkut’s University of Technology Thonburi), to transfer the VHGSF (Very High Gravity - Simultaneous Saccharification and Fermentation) ethanol production technology to neighboring countries, the main

targeted outcome of component one. The capacity of KMUTT to transfer “the know-how and know-why” of the developed technology package for the production of sustainable production of bioethanol from cassava was effectively enhanced by the project, although the TE states that “the capacity was not sufficiently improved as to facilitate access by policy decision-makers, entrepreneurs, and investors, to relevant information for decision making purposes”.

An information hub, in the form of a website, was established for the dissemination and support of the south-south technology transfer related to cassava and bioethanol production. However, the TE states that the website “does not focus on supporting technology transfer by facilitating access to relevant information for policy decision-makers, entrepreneurs, and investors”. An ethanol technology package, available in Thai and Viet Nameese languages, was produced and disseminated. Manual toolkits and training programs for technology transfer were developed. A database on ethanol technology was developed and maintained, although “it does not include relevant information related to TT (technology transfer) like ethanol and gasohol markets, description of concerned technologies and trends in their implementation, etc.”

- Component 2: South-South technology transfer: capacity building and policy dialogue with participants from LMV

The project mostly succeeded in creating a conducive environment to promote bio-ethanol technology and strengthened policies to promote ethanol for the replacement of conventional fuels, the main targeted outcome of component two. Some project activities contributed to creating regional awareness on the bioethanol technology to be transferred, but no regional or national awareness raising workshops, which had been planned, were organized. The project also succeeded in creating, through several training workshops, a cadre of “trained and motivated” farmers, entrepreneurs, specialists, engineers, scientists and researchers in Lao PDR and Viet Nam, and laid a solid foundation to improve the bioenergy policy and pricing practices in Lao PDR and Viet Nam for the promotion of Bioethanol production from cassava.

- Component 3: Demonstration and commercialization of the technology and private sector development

The TE explains that outputs related to the involvement of the private sector in commercial scale technology implementation achieved little progress. Even though two demonstration plants and a training center for bioethanol production were established as planned, several project outputs related to private sector involvement were either never carried out or produced results that were below project targets. One example is the number of companies that committed themselves to introduce the bioethanol technology and receive technical assistance.

In sum, the project was mostly successful in achieving project objectives under its first two components, by enhancing capacity for south-south technology transfer and improving the policy environment for the promotion of bioethanol technology, but mostly failed to substantially involve the private sector and commercialize the said technology under component three, thus justifying the ‘moderately satisfactory’ rating of this TER.

4.3 Efficiency	Rating: Satisfactory
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The TE rates the project's efficiency as 'satisfactory', and this TER also rates efficiency as satisfactory, as the use of GEF and co-financing funds mostly corresponded to completed outputs and achievements.

It is important to note, however, that project implementation was delayed 2 years due to changes in the main Thai executing partner, which in turn was due to "political turmoil in Thailand" and the delay in the signing of the sub-contract between UNIDO and the main executing partner (see section 5.2).

The distribution of expenditure per project component was quite asymmetric. Half (50%) of the GEF funding, or USD 1.3 million was assigned to component three, under which "the most resource-demanding outputs were fully achieved". Project resources allocated for hiring experts and institutions to prepare feasibility studies and provide technical support to governmental institutions, private companies engaged in technology absorption and the decision-making process of the project in Lao PDR and Viet Nam, "have been effectively used" according to the TE. It is important to note, however, that these funds may have been used efficiently, but were not fully effective, given that component three did not achieve its objectives (see 'Effectiveness' section).

The TE notes that for project components 1 and 2, project expenses were also used "very effectively". Most of the planned outputs have been fully achieved and even additional activities, to support the improvement of bioethanol promotion policy in Lao PDR for instance, have been developed.

Planned project co-financing was USD 31.6 million, out of a total project budget of USD 34.2 Million. Most of those funds were related to planned investments in commercial and demonstration plants and are concentrated in component two. There were no major issues with the materialization of co-financing.

At the time of the terminal evaluation, the TE reports that project expenses represent 86% of the project budget.

In conclusion, project budget has been used efficiently. Despite the initial delay in the project startup, the TE reports that most project activities have been accomplished in an even shorter effective period than the one originally planned (June 2014 – December 2018). Financial planning has proven to be adequate, and co-financing by the Viet Nam Food Industries Research Institute (FIRI), Laos's Institute for Renewable Energy Promotion (IREP), and Thailand's King Mongkut's University of Technology Thonburi (KMUTT) "effected for activities that have required this contribution". A minor mentioned issue was that FIRI complained that UNIDO's release of funds, after progress reports were delivered, was delayed (TE, p46).

4.4 Sustainability	Rating: Moderately Likely
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The TE rates 'sustainability of benefits' as 'very likely' and this TER rates sustainability as moderately likely, given that the effect of the achieved technology transfer outcome should stay in place in the short-medium term after completion of the project, but there is some uncertainty in terms of financial sustainability and private sector involvement.

The main risk to the sustainability of the project outcome is that "the conditions for the provision of this kind of comprehensive services will not subsist in the future". The TE provides some risk factors (TE, p41):

- The governmental approach seeks to develop the market through pricing strategies, instead of supporting the whole value chain of bioethanol production from cassava.
- The regulatory framework for the promotion of bioethanol is not improved.
- Lack of financing to receive services by the bioethanol consortium.
- Lack of opportunities for private investors to have access to objective and direct information about the performance of bioethanol production technology in demonstration conditions.
- Shortage of technical advice and services for the assessment of potential investments and the development of adequate business plans.
- Over-estimation of recipient countries' national capacities to support the promotion of bioethanol production.

The approach used by the project for the promotion of biofuels, a South-South Technology transfer, holds many potential advantages. However, it also entails a risky challenge due to the complexity of the operation and the lack of a representative number of success stories at international level that could be used for reference.

Financial sustainability

The TE reports a "lack of [...] confidence in the policy framework for biofuel promotion that is still under development, and the financial barriers to access loans in appropriate conditions have prevented these companies [...] to invest in bioethanol production with the VHGSST technology". The number of companies that have committed themselves to introduce the project's main technology and that have received technical assistance "is well below project targets". While the project was able to set up demonstration facilities and pilot plants, the project did not take advantage of the demonstration process to engage private investors. For this same reason, it was not possible to develop a set of opportunities and feasibility studies of real cases for absorption of the bioethanol production technology.

Therefore, one of the most vulnerable outcomes of the project is "the still incipient engagement" of the private sector in the introduction of new technology for bioethanol production.

Sociopolitical sustainability

The participating governments realize the importance of bio-ethanol development to replace traditional imported fossil fuels, but the formulation of transparent policies and incentives to promote bioenergy requires coordination among key government agencies. The TE notes that other key stakeholders, such as the private sector, are likely to fall in line when the government sends a strong policy signal. But the

project has had limited impacts of sharing the Thai experience of bio-ethanol promotion initiatives with the neighboring countries, in the sense that the governments of Laos, Viet Nam and Myanmar are just starting to create socio-political environments that are conducive to the promotion of biofuels (see below).

Institutional sustainability

The four countries (Thailand, Viet Nam, Myanmar, Laos) involved in this project face different institutional barriers related to the development and promotion of biofuels.

In the case of Thailand, barriers refer to bioethanol development for fuel promotion, specifically the security of raw material supply, pricing and confidence of relevant actors in the policy regulatory framework.

In the case of Viet Nam, barriers focus on the need to improve policy instruments and framework.

In the case of Laos and Myanmar stated barriers are the lack of adequate policy and technical capacity.

All these countries are net fuel importers and the reduction of petroleum products consumption, including gasoline and diesel, is a priority. During the project implementation period (2012-2018), reliance on fuel imports was reinforced significantly, due to an increase in fuel consumption as a result of strong economic growth. In response to this situation, Viet Nam and Laos have declared the promotion of biofuels a priority of their national renewable energy development strategies. Viet Nam has stated that it hopes to achieve a 100% substitution of pure gasoline by gasohol (a mixture of gasoline and ethyl alcohol used as fuel in internal combustion engines) in 2018, and Lao PDR is seeking to achieve 10% replacement of gasoline by gasohol by 2025. Promotion of bioethanol production is supported by National Biofuel Programs or Strategies in the aforementioned countries and in Thailand. Thus, in all the involved countries, governments have developed actions seeking to implement a policy conducive to the reduction of petroleum imports and have specific targets and roadmaps to replace gasoline with different bioethanol blends. This situation creates an “affirmative policy environment” to keep biofuel promotion as a national priority. Furthermore, the TE notes that the fact that project outcomes are the result of south-south technology transfer is a positive contribution to their sustainability (TE, p40).

This positive policy context bodes well for the sustainability of project outcomes.

Environmental sustainability

There are no identified potential risks to environmental sustainability. The development of bioenergy to replace fossil fuels should result in positive environmental impacts and increased sustainability in the near future.

5. Processes and factors affecting attainment of project outcomes

5.1 Co-financing. To what extent was the reported co-financing essential to the achievement of GEF objectives? If there was a difference in the level of expected co-financing and actual co-financing, then what were the reasons for it? Did the extent of materialization of co-financing affect project's outcomes and/or sustainability? If so, in what ways and through what causal linkages?

In terms of co-financing, the planned figure was as high as USD 31.6 million, out of a total planned project budget of USD 34.2 million, while the GEF grant, at USD 2.6 million, represents 8% of the total. The bulk of the co-financing funds, 25 million USD out of 31.6 million, was provided by the private sector. The co-financing funds were thus essential to the achievement of the project objectives and were mostly directed to investments in commercial and demonstration plants under component two.

The TE reports that financial planning “has proven to be adequate”, and co-financing by the Viet Nam Food Industries Research Institute (FIRI), Laos's Institute for Renewable Energy Promotion (IREP), and Thailand's King Mongkut's University of Technology Thonburi (KMUTT) “effected for activities that have required this contribution”. There were no major issues with the materialization of co-financing (TE, p46).

5.2 Project extensions and/or delays. If there were delays in project implementation and completion, then what were the reasons for it? Did the delay affect the project's outcomes and/or sustainability? If so, in what ways and through what causal linkages?

The TE reports that the project startup has been challenging. The project implementation was approved to start in February 2012. The National Science and Technology Development Agency (NSTDA) of Thailand was supposed to act as the main national project executing partner. However, after Thailand's cabinet reshuffle in the fourth quarter of 2012, the Ministry of Science and Technology, under which the NSTDA operates, changed its priorities. As a result, in January 2013, NSTDA decided to drop the project. After a period of consultancies and meetings during 2013, UNIDO and King Mongkut University of Technology Thonburi (KMUTT) agreed that the latter would take on NSTDA's planned activities.

The first project steering committee meeting was held in December 2013, which is considered actual starting date of the project. Real project activities commenced only in June 2014 after the agreement between KMUTT and UNIDO was signed, 20-28 months later than expected. To a large extent the delay was a direct consequence of Thailand's complex political situation at the time, known as the “2013-2014 Thai political crisis”. The most direct consequence of this situation was the need to find a new main project partner to proceed with an effective project startup. The process of signing a contract with Viet Namese institutions also took a long time and that brought about delays, the TE notes. Subsequently, the project closing date also changed during project implementation. While the original closing date was January 2016, the project ultimately was extended three times, and closed in December 2018 (TE, p9).

Despite these delays, the TE reports that most project activities have been accomplished in an even shorter effective period than the one originally planned (June 2014 – December 2018).

5.3 Country ownership. Assess the extent to which country ownership has affected project outcomes and sustainability? Describe the ways in which it affected outcomes and sustainability, highlighting the causal links:

This project aims to support the transfer of technology for ethanol production from cassava developed by KMUTT (Thailand) to private companies and R&D institutions from Viet Nam, Lao PDR and Myanmar. As such, the project addresses a problem that is relevant for most of countries of the region and most developing countries in general. Reduction of fuel imports is a priority in every national development strategy of petroleum net importer countries, the TE notes. The technology promoted by this project to address this problem is in the utmost interest of many countries, especially those involved in this project. It offers an alternative option to raw materials commonly used for bioethanol production: molasses and corn (TE, p50).

The four countries involved in this project are net fuel importers and the reduction of petroleum products consumption, including gasoline and diesel, is a priority. During the project implementation period (2012-2018), reliance on fuel imports was reinforced significantly, due to an increase in fuel consumption as a result of strong economic growth. In response to this situation, Viet Nam and Laos have declared the promotion of biofuels a priority of their national renewable energy development strategies. Viet Nam hopes to achieve a 100% substitution of pure gasoline by gasohol (a mixture of gasoline and ethyl alcohol used as fuel in internal combustion engines) in 2018, and Lao PDR is seeking to achieve 10% replacement of gasoline by gasohol by 2025. Promotion of bioethanol production is supported by National Biofuel Programs or Strategies in the aforementioned countries and in Thailand. Thus, in all the involved countries, governments have developed actions seeking to implement a policy conducive to the reduction of petroleum imports and have specific targets and roadmaps to replace gasoline with different bioethanol blends (TE, p17).

In sum, country ownership has been strong throughout the project, and will continue this way as long as these countries rely on costly imported import fuel to sustain their fast economic growth.

6. Assessment of project's Monitoring and Evaluation system

Ratings are assessed on a six point scale: Highly Satisfactory=no shortcomings in this M&E component; Satisfactory=minor shortcomings in this M&E component; Moderately Satisfactory=moderate shortcomings in this M&E component; Moderately Unsatisfactory=significant shortcomings in this M&E component; Unsatisfactory=major shortcomings in this M&E component; Highly Unsatisfactory=there were no project M&E systems.

Please justify ratings in the space below each box.

6.1 M&E Design at entry	Rating: Moderately satisfactory
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The TE rates the project's overall M&E system as 'satisfactory'. This TER rates the project's M&E design at entry as moderately satisfactory, given that the M&E system design was flawed.

The project design was weak as it was prepared without the full and active participation of relevant national stakeholders and with a lack of insight regarding CO2 emissions abatement, the TE notes. As a result, the Project Results Framework (PRF) and target indicators were not developed well enough to address key barriers and associated risks and are not useful for guiding project monitoring. The PRF is a central component of the project design. This tool shows the interconnection between project goals, objectives, outcomes, and outputs. It also indicates how to measure project progress. The PRF defines the indicators, their baseline and the targets. However, most result indicators are not SMART (specific, measurable, attainable, relevant and time-bound) and most target indicator formulations are inappropriate. Most of them are expressed in terms of achievement of the expected output but not in terms of the expected impacts of achieved outputs, except for those related to training activities, pilot and demonstration plants. Furthermore, none of the indicators are time bound (TE, p15).

The annual workplan included planning of required activities for completion of every output. The work plan was annually updated and approved by the project steering committee meetings. But there was no specific monitoring and evaluation plan with the right indicators and targets focusing on outputs. A detailed monitoring plan for tracking and reporting on project time-bound milestones and accomplishments was not laid out. Progress reports and Project Management Unit reports to project steering committee meetings were always result oriented, the TE notes (TE, pXI).

The budget for the M&E plan was included in the general Project Budget. Table 10 of the TE provides a tentative budget for the M&E system (TE, p45).

These shortcomings in the design of the M&E system justify the 'moderately satisfactory' rating given in this TER.

6.2 M&E Implementation	Rating: Satisfactory
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The TE rates the project's overall M&E system as 'satisfactory', and this TER also rate the project's M&E implementation as satisfactory, as all expected monitoring reports were delivered appropriately and provided timely and useful information.

The TE states that project team had access to relevant monitoring reports: Progress reports, Project Implementation Reviews (PIRs) and the Mid Term Evaluation Report. All these documents are stated to be informative, include relevant information for the evaluation and provide insight about project implementation. These technical reports allowed the evaluation team to have a deeper and better

understanding of processes, circumstances and technical questions related to the achievement of project outputs (TE, p2).

The M&E system was established in accordance with UNIDO and GEF guidelines and procedures, the TE notes. The M&E system is based on the Project Implementation Reports (PIRs), the Mid-term Review (MTR) and the Terminal Evaluation. All the PIRs have been issued during the project implementation period and prepared according to the guidelines. Reported information is of good quality and includes details that provide additional value as a monitoring tool, as stated by the TE. The MTR was provided as planned. This report included recommendations to improve the project implementation process. The planned M&E system was complemented by the annual progress reports elaborated by KMUTT (King Mongkut's University of Technology Thonburi, Thailand) and by the project steering committee meetings (TE, p45).

7. Assessment of project implementation and execution

Quality of Implementation includes the quality of project design, as well as the quality of supervision and assistance provided by implementing agency(s) to execution agencies throughout project implementation. Quality of Execution covers the effectiveness of the executing agency(s) in performing its roles and responsibilities. In both instances, the focus is upon factors that are largely within the control of the respective implementing and executing agency(s). A six point rating scale is used (Highly Satisfactory to Highly Unsatisfactory), or Unable to Assess.

Please justify ratings in the space below each box.

7.1 Quality of Project Implementation	Rating: Highly Satisfactory
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The TE rates the United Nations Industrial Development Organization (UNIDO)'s performance as 'satisfactory', stating that the UN agency "accomplished its assigned duties with some limitations". This TER rates UNIDO's implementation as highly satisfactory, as it succeeded in implementing project activities despite a challenging political and institutional environment.

The TE notes that "This evaluation benefitted from very productive teamwork among UNIDO Energy Department staff directly involved in this TE, UNIDO regional office in Bangkok, the PMU (Project Management Unit) and the evaluation team".

To UNIDO's credit, coordination and management of this project was a real challenge. This project executed activities in four different countries, with "different economic situations, infrastructure, and political environment (s)". Relevant project stakeholders include a mix of ministries and ministerial departments, research institutes and universities, and private sector companies.

To undertake the coordination of the project, day to day operations and assist project partners in the organization of activities according to the work plan, UNIDO established a project management unit (PMU). This PMU was in full composition during the whole implementation period, except for the position of administrative staff that was not filled during 2018. Membership of the PMU was very stable during the implementation period, the TE reports. The only changes were the person nominated by the National Science and Technology Development Agency (NSTDA) that was replaced by a person nominated by King Mongkut's University of Technology Thonburi (KMUTT) in 2014 and later the designation of a new project coordinator in October 2015. This stability is one of the PMU's strengths and a real contribution to project coordination, the TE notes. The PMU has been very active and has efficiently fulfilled its duties.

The adaptive approach of project management has been a relevant aspect of the implementation, the TE notes. Therefore, the project team was able to overcome situations that could have seriously jeopardized project performance, such as the political instability in Thailand and the change of government and energy policy in Myanmar. The process of selection of the new partner and the agreement of the conditions to become a new project participant were well managed by the UNIDO office and PMU, as stated in the TE (TE, p48).

7.2 Quality of Project Execution	Rating: Satisfactory
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The TE rated each involved executing agency individually, assigning a 'satisfactory' rating to all four entities: King Mongkut's University of Technology Thonburi (KMUTT), Thailand; Liquor Distillery Organization (LDO), Thailand; Ministry of Industry and Trade (MOIT), Viet Nam; and Food Industries Research Institute (FIRI), Viet Nam. This TER also rates project execution as 'satisfactory', as all the involved agencies fulfilled their duties and showed commitment to the project, especially KMUTT which had to operate under a complex political situation.

KMUTT has a leading role in the project, as it played the role of technology transferor. KMUTT "adequately fulfilled" its leading role and completed most assigned outputs as per schedule, despite political upheaval in Thailand. KMUTT provided almost 3 million USD of co-financing to the project.

FIRI showed a high commitment to project activities but could not achieve some of the assigned output concerning private sector involvement. A training center was established at FIRI Viet Nam to disseminate and provide training on the new technology package. FIRI provided over 1 million USD of co-financing to the project.

MOIT was committed to project implementation. It supported the project, attended project steering committee meetings and contributed 375 000 USD to the project, while IREP played an important role in supporting project implementation in Laos (TE, p76).

8. Assessment of Project Impacts

Note - In instances where information on any impact related topic is not provided in the terminal evaluations, the reviewer should indicate in the relevant sections below that this is indeed the case and identify the information gaps. When providing information on topics related to impact, please cite the page number of the terminal evaluation from where the information is sourced.

8.1 Environmental Change. Describe the changes in environmental stress and environmental status that occurred by the end of the project. Include both quantitative and qualitative changes documented, sources of information for these changes, and how project activities contributed to or hindered these changes. Also include how contextual factors have contributed to or hindered these changes.

This project aimed to remove barriers and create a conducive environment to promote the adoption of ethanol production technology from cassava. As such, there were no direct impacts on the environment at this point. But the project's ultimate goal would be to use bioenergy as an alternative to fossil fuels – which are limited resources and are mostly imported in the case of these four countries – as a way to reduce greenhouse gas (GHG) emissions and improve energy security and autonomy. Therefore, biomass is considered a promising alternative energy source in future strategic energy planning in the national and regional context. Indeed, bioenergy is an attractive energy resource since it is renewable, widely available and carbon neutral. In sum, the project should result in positive environmental change in the near future.

8.2 Socioeconomic change. Describe any changes in human well-being (income, education, health, community relationships, etc.) that occurred by the end of the project. Include both quantitative and qualitative changes documented, sources of information for these changes, and how project activities contributed to or hindered these changes. Also include how contextual factors have contributed to or hindered these changes.

Given that the project aimed to remove barriers and create a conducive environment to promote the adoption of biofuels, there were no reported socioeconomic changes. The project addresses a problem that is relevant for most of countries of the region and most developing countries that import fuel. Therefore, by contributing to the development of biofuels as an alternative to traditional fossil fuels, positive socioeconomic changes, in the form of reduced imports, increased domestic production of renewable energy, and possibly lower fuel costs, should occur in the short to medium term, affecting income as well as health through reduced greenhouse gas (GHG) emissions.

8.3 Capacity and governance changes. Describe notable changes in capacities and governance that can lead to large-scale action (both mass and legislative) bringing about positive environmental change. “Capacities” include awareness, knowledge, skills, infrastructure, and environmental monitoring systems, among others. “Governance” refers to decision-making processes, structures and systems, including access to and use of information, and thus would include laws, administrative bodies, trust-

building and conflict resolution processes, information-sharing systems, etc. Indicate how project activities contributed to/ hindered these changes, as well as how contextual factors have influenced these changes.

a) Capacities

The project had certain capacity-building activities within its components. The outcome of component one (Institutional capacity strengthening for VHG-SSF technology dissemination), to create capacity in Thailand to support the technology transfer of the bioethanol technology package and enhance experience in the development of an enabling policy environment for the promotion of such technologies, is deemed to have been “almost fully achieved”. Specifically, the capacity for the transfer of the know-how and know-why of the developed technology package for the production of sustainable production of bioethanol from cassava was enhanced. This was the most important accomplishment of the project: readying the technology package to be transferred for bioethanol and cassava production. The technology package’s technical components were prepared and provided by KMUTT (by King Mongkut's University of Technology Thonburi). As such, the project contributed to the capacity of Thai institutions to promote a genuine south-south technology transfer process of the above mentioned technology package and to the cadre of technicians, farmers, researchers, entrepreneurs and governmental officials that have been trained and motivated, creating a solid foundation for the consolidation and extension of the project for the reduction of fuel imports. These project activities increased the capacity of relevant actors to create a conducive environment for the development of bioethanol (TE, p50).

This capacity is concentrated in a consortium of Thai institutions, led by KMUTT and made up of the Thai Tapioca Development Institute (TTDI), the Cassava Starch Research Laboratory hosted by Kasetsart University and the National Center for Genetic Engineering and Biotechnology (BIOTEC). All knowledge, skills and know-how that these institutions are transferring are part of their core strengths. The added value of the project has been to complement these capacities and develop synergies to achieve a common goal, namely to create a conducive environment for the replacement of fossil fuels with biofuels.

The report “Bioethanol Development Plan 2018 – 2025” indicates that Lao PDR’s bioethanol development is in its incipient phase. However, some advances have been made in institutional capacity for policy implementation such as:

- The Government has set up a bioenergy task force under the Ministry of Energy and Mines (MEM) and The Ministry of Science and Technology (MOST), Thailand.
- The MEM has already setup the Institute of Renewable Energy Promotion (IREP) as the core bioethanol development organization in Lao PDR.

However, this capacity was not sufficiently improved as to facilitate access by policy decision-makers, entrepreneurs and investors to relevant information for decision making purposes. The TE notes that these activities “fell short to raise regional awareness about bioethanol production from cassava as planned”. Furthermore, as explained in section 5.2, the process of signing a contract with Viet Nameese institutions took a long time and brought about a delay. This delay in achieving the improvement of the

policy environment in Viet Nam was compensated by progress in this field achieved in Lao PDR, the TE explains (TE, p36).

b) Governance

The participating governments realize the importance of bio-ethanol development to replace traditional imported fossil fuels, but the formulation of transparent policies and incentives to promote bioenergy requires coordination among key government agencies. The TE notes that other key stakeholders, such as the private sector, are likely to fall in line when the government sends a strong policy signal. But the project has had limited impacts of sharing the Thai governance experience of bio-ethanol promotion initiatives with the neighboring countries, in the sense that the governments of Laos, Viet Nam and Myanmar are just starting to create socio-political environments that are conducive to the promotion of biofuels. The four countries (Thailand, Viet Nam, Myanmar, Laos) involved in this project face different institutional barriers related to the development and promotion of biofuels, which are detailed in the 'Sustainability' section (4.4) of this TER.

Nonetheless, the increase in fuel consumption and importation during the implementation of the project led to a reaction from the participating governments. As mentioned earlier, Viet Nam and Laos declared the promotion of biofuels a priority of their national renewable energy development strategies. Viet Nam hopes to achieve a 100% substitution of pure gasoline by gasohol (a mixture of gasoline and ethyl alcohol used as fuel in internal combustion engines) in 2018, and Lao PDR is seeking to achieve 10% replacement of gasoline by gasohol by 2025. Promotion of bioethanol production is supported by National Biofuel Programs or Strategies in the aforementioned countries and in Thailand. Thus, in all the involved countries, governments have developed actions seeking to implement a policy and governance context conducive to the reduction of petroleum imports, and have specific targets and roadmaps to replace gasoline with different bioethanol blends. This situation creates an "affirmative policy environment" to keep biofuel promotion as a national priority (TE, p17).

Output 2.4, "Pricing practices and policy environment improved", is deemed to have been "achieved", through expert level training workshops to create a better policy framework; the promotion of pricing mechanisms; policy and pricing tools intervention; a policy forum; and an awareness campaign to popularize biofuels among Viet Nameese consumers. All activities were successfully developed. In addition, several non-initially planned activities were carried out in Lao PDR at the Government's request. These activities contributed to improving the conditions to enhance the policy environment for the promotion of bioethanol production from cassava for the local fuel market

8.4 Unintended impacts. Describe any impacts not targeted by the project, whether positive or negative, affecting either ecological or social aspects. Indicate the factors that contributed to these unintended impacts occurring.

There were no reported unintended impacts of the project.

8.5 Adoption of GEF initiatives at scale. Identify any initiatives (e.g. technologies, approaches, financing instruments, implementing bodies, legal frameworks, information systems) that have been mainstreamed, replicated and/or scaled up by government and other stakeholders by project end. Include the extent to which this broader adoption has taken place, e.g. if plans and resources have been established but no actual adoption has taken place, or if market change and large-scale environmental benefits have begun to occur. Indicate how project activities and other contextual factors contributed to these taking place. If broader adoption has not taken place as expected, indicate which factors (both project-related and contextual) have hindered this from happening.

As explained earlier, project outputs related to the involvement of the private sector in commercial scale technology implementation achieved little progress. Even though two demonstration plants and a training center for bioethanol production were established as planned, several project outputs related to private sector involvement were either never carried out or produced results that were below project targets. One example is the number of companies that committed themselves to introduce the bioethanol technology and receive technical assistance. Specifically, for output 3.5: “Private sector assisted in project development for project replication”, whose indicators are related to the identification of private investors interested in investing in transfer of technology and “at least 5 replication projects developed in Thailand and LMV countries.” The number of companies that committed themselves to introduce the the project’s technology and receive technical assistance is well below these project targets. This indicator suggested that private investors would be able to develop a project and present it to banking institutions for financing in a relatively short period, which was very unlikely considering existing institutional barriers, the TE notes. Likewise, according to the project concept and TE, Thailand should not have been included in this indicator because this country is the transferor in this technology transfer process (TE, p16).

Output 3.3 succeeded in achieving “A demonstration plant established in Viet Nam with an ethanol production capacity of 50 l/d capacity”. This facility significantly increased Viet Nam Food Industries Research Institute’s (FIRI) capacity to support the technology transfer of bioethanol production technologies. This contribution is not only via training and demonstration. Viet Nameese private companies have expressed their interest in using the pilot plant to test raw material, new products, and different production process regimens. As such, this demonstration plant could lead to replication of the technology and process in Viet Nam.

9. Lessons and recommendations

9.1 Briefly describe the key lessons, good practices, or approaches mentioned in the terminal evaluation report that could have application for other GEF projects.

The project addresses a problem that is relevant to most countries in the region and most developing countries, which is the reduction of fuel imports, a priority in every national development strategy of net oil importing countries. The technology promoted by this project to address this problem is in the economic interest of many countries, in addition to the environmental benefits of substituting oil for biofuel. The approach used by the project for the promotion of this alternative, a south-south technology

transfer between Thailand and three neighboring countries, holds several potential advantages. However, this approach also entails a risky challenge due to its complexity and the lack of a representative number of success stories at international level that could be used for reference. Some project design failures, a complex political situation during the startup process, and the implementation of activities in four different countries posed additional difficulties for the coordination and management of the project. UNIDO, the implementing agency, and the project management unit adopted an effective adaptive approach to problem-solving, while relevant partners and stakeholders showed commitment to the project. But the achievement of the planned project outcomes was limited, the TE notes. This is especially true for component three, which entailed involving the private sector and replicating the project's technology package commercially. Nonetheless, accomplishments of the project, such as the technology package readied to be transferred for bioethanol and cassava production; the consolidation of the capacity of Thai institutions for the promotion of a genuine south-south technology transfer process of the above mentioned technology package; and the cadre of technicians, farmers, researchers, entrepreneurs and governmental officials that have been trained and empowered, have together created "a solid foundation for the consolidation and extension of the project for the reduction of fuel imports" (TE, pxii).

The TE describes four main lessons learned from this project:

- When designing technology transfer projects, the selection of the scope and range of outputs related to pilot, demonstration and commercial plants is a critical factor for achieving a good project performance; objective and thorough considerations about existing conditions for specific technology transfer actions should be provided; and special attention should be paid to the project timeframe and financial resources constraints while deciding what outputs can be planned and achieved in the scope of the project.
- Outputs focused on improving policy framework should be defined only in terms of delivery of recommendations or inputs supporting decision-making processes. In other words, these outputs should be designed and framed in a more realistic and achievable way.
- Outputs seeking private sector involvement in the technology transfer, such as those formulated under component three, should be business-oriented and more closely in tune with companies' real needs and expectations.
- In technology transfer projects special attention should be paid to the selection of project partners, executing agencies and their roles. Conflicts of interest and ethical contradictions should be avoided.

9.2 Briefly describe the recommendations given in the terminal evaluation.

The TE provides three sets of recommendations, to the GEF, to UNIDO, and to the governments of participant countries:

To the GEF:

- This project has demonstrated that for developing countries relevant solutions for facing climate change involve not only the industrial sector but also the agriculture sector. Biofuels can help

reduce greenhouse gas (GHG) emissions and provide renewable energy for transportation and other uses, contributing to both climate change mitigation and adaptation.

To UNIDO:

- In the case of bioenergy projects like this one, where the energy intervention depends on the supply of biomass, it is recommended to base the project design on the concept of agribusiness, for commercialization and private sector involvement purposes.
- Identify opportunities to maintain support of bioethanol production technology transfer in the region after project completion, to take advantage of the positive momentum created by this project.
- Improve the technical and methodological internal review of project proposals during the approval process.
- Establish a reporting mechanism that provides information on the actual expenditure of co-financing on a regular basis.

To the governments of participant countries:

- Participant countries should use existing mechanisms or if necessary, establish new ones, to ensure the consolidation of cross-border and/or south-south technology transfer activities initiated by the project focusing on supporting national biofuel development priorities. An available opportunity for doing that is the existing Thai and regional mechanisms for cooperation for development. The Thailand International Development Cooperation Agency (TICA) is responsible for the implementation of Thailand's development cooperation programmes in neighboring countries and promotes South-South cooperation and North-South-South cooperation. At the regional level, the Association of South-East Asian Nations (ASEAN) implements similar cooperation mechanisms between member countries.
- While improving the effectiveness of the policy framework for promoting biofuels, special attention should be paid to policy tools for increasing the participation of private companies and farmers in bioethanol and cassava production, such as tax and retail price incentives both for bioethanol and cassava producers; support for capacity building programmes for company staff and farmers to increase their knowledge and training on new technologies; government contributions to investments for developing necessary infrastructure for bioethanol commercialization and to specific research and development to help adapt technology to local conditions; and communication campaigns focused on increasing the social acceptance of biofuels.
- Continue providing support for capacity building activities using training modules developed by the project and aimed at relevant actors for bioethanol, such as members of governmental bodies, personnel belonging to engineering and consulting companies, technical and senior staff of bioethanol companies and farmers.
- Involve research centers and universities in these activities.

10. Quality of the Terminal Evaluation Report

A six point rating scale is used for each sub-criteria and overall rating of the terminal evaluation report (Highly Satisfactory to Highly Unsatisfactory)

Criteria	GEF IEO comments	Rating
To what extent does the report contain an assessment of relevant outcomes and impacts of the project and the achievement of the objectives?	The report contains a satisfactory assessment of project outcomes and impacts, even though this was difficult for this project as it aimed to create a conducive environment for biofuels development and promotion, rather than have direct and tangible impacts.	S
To what extent is the report internally consistent, the evidence presented complete and convincing, and ratings well substantiated?	The report is consistent in pointing out the project's strengths and weaknesses. Its ratings sections is clear and logical, although one of the executing agencies is not evaluated.	S
To what extent does the report properly assess project sustainability and/or project exit strategy?	The report properly assesses risks to sustainability, although these are not categorized, and offers many recommendations to improve the project's exit strategy.	MS
To what extent are the lessons learned supported by the evidence presented and are they comprehensive?	The report's lessons learned, conclusions and recommendations are comprehensive, informative, and add value to the report.	HS
Does the report include the actual project costs (total and per activity) and actual co-financing used?	Yes, the report clearly documents co-financing and projects costs per component.	HS
Assess the quality of the report's evaluation of project M&E systems:	The report's evaluation of the project's M&E system is quite short and lacking in information and depth, although there is a detailed budget table.	MU
Overall TE Rating		S

11. Note any additional sources of information used in the preparation of the terminal evaluation report (excluding PIRs, TEs, and PADs).

- GEF-4 Climate Change Mitigation Strategy Document²

² http://www.thegef.org/sites/default/files/council-meeting-documents/GEF_4_strategy_CC_Oct_2007_1.pdf