



# Malaysia: Biomass-based Power Generation and Cogeneration in the Palm Oil Industry (BioGen) Project – Phase I

**MAL/01/G31**

## Final Evaluation Report

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**Dec 2010**

## List of Acronyms and Abbreviations

| | |
|---|---|
| AAIBE | Akaun Amanah Industri Bekalan Elektrik |
| APR | Annual Performance Report |
| ATLAS | Automatically Tuned Linear Algebra Software |
| AWFP | Annual Work and Financial Plan |
| AWP | Annual Work Plan |
| BIOGEN | Biomass-based Power Generation and Cogeneration in the Palm Oil Industry Project – Phase 1 |
| BOSC | Biomass One Stop Centre |
| BPMB | Bank Pembangunan Malaysia Berhad |
| BRIS | Biomass Resources Information System |
| CDM | Clean Development Mechanism |
| CEO | Chief Executive Officer |
| CETDEM | Centre for Environment, Technology & Development, Malaysia |
| CETREE | Centre for Education, Training and Research in Renewable Energy and Energy Efficiency |
| CHP | Combined Heat and Power |
| CH4 | Methane |
| COD | Commercial Operation Date |
| CTA | Chief Technical Advisor |
| DANCED | Danish Cooperation for Environment and Development |
| EC | Energy Commission (English for ST) |
| EFB | Empty Fruit Bunch |
| EPC | Engineering, Procurement and Construction |
| EPU | Economic Planning Unit |
| ESCO | Energy Service Company |
| ESI | Energy Service Industries |
| ESSB | Eko-Synthesis Sdn Bhd |
| ETP | Economic Transformation Programme |
| FE | Final Evaluation |
| FELDA | Lembaga Kemajuan Tanah Persekutuan |
| FFB | Fresh Fruit Bunch |
| FIT | Feed-in-Tariff |
| FMM | Federation of Malaysian Manufacturers |
| FP | Full-sized Project |
| FPI | Felda Palm Industries |
| FPISB | Felda Palm Industries Sdn Bhd |
| FRIM | Forest Research Institute Malaysia |
| FSM | Full Scale Model |
| GDP | Gross Domestic Product |
| GEF | Global Environmental Facility |
| GHG | Greenhouse Gas |
| GoM | Government of Malaysia |
| GTFS | Green Technology Financial System |
| HAZOP | Hazard Operationability |
| ILSAS | Institute Latihan Sultan Ahmad Shah |

| | |
|---|---|
| IPP | Independent Power Producer |
| JAAIBE | Jawatankuasa Akaun Amanah Industri Bekalan Elektrik (also see MESITA) |
| JBEG | Jabatan Bekalan Gas Malaysia |
| KL | Kuala Lumpur |
| KOP | Kluang Oil Processing Sdn Bhd |
| LFA | Logical Framework Analysis |
| MASB | MHES Asia Sdn. Bhd. |
| MBIPV | Malaysia Building Integrated Photovoltaic |
| MEGTW | Ministry of Energy, Green Technology and Water |
| MECM | Ministry of Energy, Communications and Multimedia |
| MESITA | Malaysian Electricity Supply Industries Trust Account (English for AAIBE) |
| MEWC | Ministry of Energy, Water and Communications |
| MGTC | Malaysia Green Technology Corporation (English for PTM) |
| MHES | MHES Asia Sdn Bhd |
| MIDA | Malaysian Industrial Development Authority |
| MIEEIP | Malaysian Industrial Energy Efficiency Improvement Project |
| MITI | Ministry of International Trade and Industry |
| MNRE | Ministry of Natural Resources and Environment |
| MP | Malaysia Plan |
| MoA | Memorandum of Agreement |
| MoF | Ministry of Finance |
| MOSTI | Ministry of Science, Technology & Innovation |
| MPI | Ministry of Primary Industry (now MPIC) |
| MPIC | Ministry of Plantation Industries and Commodities |
| MPOA | Malaysian Palm Oil Association |
| MPOB | Malaysian Palm Oil Board |
| MS | Marginally Satisfactory |
| MSW | Municipal Solid Waste |
| MTR | Mid-Term Review |
| M&E | Monitoring and Evaluation |
| N.A. | Not Available |
| ND | No Data |
| NGO | Non-Governmental Organization |
| NPD | National Project Director |
| NSC | National Steering Committee |
| OP | Operational Program |
| OSC | One-Stop-Centre |
| PIR | Project Implementation Review |
| PKS | Palm Kernel Shell |
| PM | Program Manager |
| PMO | Project Management Office |

| | |
|---|---|
| PMU | Project Management Unit |
| POM | Palm Oil Mill |
| POMA | Palm Oil Millers Association |
| POME | Palm Oil Mill Effluent |
| PORIM | Palm Oil Research Institute of Malaysia |
| PTM | Pusat Tenaga Malaysia |
| PV | Photovoltaic |
| RE | Renewable Energy |
| REBF | Renewable Energy Business Fund |
| REPPA | Renewable Energy Power Purchase Agreement |
| RM | Malaysian Ringgit |
| R&D | Research and Development |
| SCORE | Special Committee on Renewable Energy |
| SEDA | Sustainable Energy Development Authority |
| SIRIM | Standards and Industrial Research Institute of Malaysia |
| SREP | Small Renewable Energy Programme |
| ST | Suruhanjaya Tenaga |
| TA | Technical Assistance |
| TNB | Tenaga Nasional Berhad |
| ToR | Terms of Reference |
| UKM | Universiti Kebangsaan Malaysia |
| UNDP | United Nations Development Programme |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UNITEN | Universiti Tenaga Nasional |
| USD | United States Dollar |
| USM | Universiti Sains Malaysia |
| UTM | Universiti Teknologi Malaysia |
| VSREP | Very Small Renewable Energy Programme |

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**(BioGen) Project – Phase I**
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**(Draft) FINAL EVALUATION REPORT**

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## PROJECT IDENTIFICATION

| | |
|---|---|
| **Official Project Title** | PIMS 1030 - Malaysia: Biomass-based Power Generation and Cogeneration the Palm Oil Industry (Phase 1) |
| **Project Short Title** | BioGen Project) |
| **Project Summary** | |
| This project aims to reduce the growth rate of greenhouse gas (GHG) emissions from fossil fuel fired combustion processes & unutilized biomass waste through the acceleration of the growth of biomass-based power generation & combined heat and power (CHP). It also aims to develop and exploit the energy potentials of biomass waste realized through the successful implementation of programs such as: 1. Information services & awareness enhancement; 2. Policy studies & capacity building; 3. Financial assistance for biomass energy projects; 4. Demonstration schemes; and 5. Biomass energy technology development. The description of Phase 2 activities has been included in this project document (Annex 7) to provide information on the context of the larger project. However, the financial commitment under this project document is limited to Phase 1 activities only. | |
| **Project Number:** | MAL/01/G31 |
| **PIMS Number:** | 1030 |
| **Atlas Award Number:** | 00013487 |
| **Atlas Project Number (s):** | 13487 |
| **Project Type:** | Full-sized Project (FP) |
| **GEF Focal Area:** | Climate Change Mitigation |
| **GEF-4 Focal Area Strategic Program:** | • Improved access to local financing of renewable energy (RE) projects<br>• Establishment of regulatory frameworks supportive of RE projects |

| **Project Milestones and Timeframe** | |
|---|---|
| Pipeline entry OR PIF approval : | 15-Jun-2000 |
| GEF CEO endorsement/approval date: | 15-Mar-2002 |
| Project Document Signature date: | 26-July-2002 |
| Date of First Disbursement[1]: | 31-Mar-2003 |
| Original Planned Closing Date: | 31-Dec-2004 |
| First Revised Planned Closing Date: | 31-Dec-2007 |
| Date project manager hired: | 01-Jan-2003 |
| Actual date of operational closure in ATLAS (if applicable) | |
| Second Revised Planned Closing Date | 30-Jun-2010 |
| Planned date of financial closure in Atlas | 31-Dec-2010 |
| Website address (URL) of Project | www.bris.org.my |

| **Summary of Project Inputs (in US$)** | |
|---|---|
| **UNDP/GEF** | **4,000,000** |
| **CO-FINANCING** | |
| Government (in cash): | 3,025,600 |
| Government (in kind): | 804,820 |
| Private Sector (in cash): | 6,518,500 |
| Private Sector (in kind): | 385,270 |
| **Total Co-Financing** | **10,734,190** |
| **TOTAL** | **14,734,190** |

## EXECUTIVE SUMMARY

The Biomass-based Power Generation and Cogeneration the Palm Oil Industry (BioGen) Project is a GEF Operational Program (OP)-6 project, was nationally-executed by Ministry of Energy, Green Technology and Water (MEGTW) and implemented by the Malaysia Green Technology Corporation (MGTC – previously known as Pusat Tenaga Malaysia (PTM). BioGen is a priority project for Malaysia and UNDP/GEF's assistance in this project was instrumental in ensuring a wide-spread promotion of biomass and biogas waste from palm-oil mills for displacing part of the fossil fuels used in electricity production. The project was approved for Phase 1 implementation on the understanding that Phase 2 can only proceed upon successful completion of Phase 1. BioGen Phase 1 was provided GEF funds amounting to USD 4 million and a co-financing fund total of USD 10,734,190. The total project cost was USD 14,734,190.

The project was organized among the institutions and groups related to the Malaysian palm oil industry and these stakeholders were expected to benefit from this palm oil biomass utilization and application project. There were also major activities and sub-components of the project that were led by co-operating agencies (such as Malaysian Palm Oil Board (MPOB) and Bank Pembangunan Malaysia) based on the mandate agreed during the project design.

The GEF approved the project on March 15, 2002 and its Project Document (ProDoc) was signed by UNDP and the GoM on July 26, 2002 and it is expected to be implemented in two years time, which was expected to be completed in December 2004. Considering the delays in implementation, a year extension was recommended and granted by the project's National Steering Committee (NSC) placing the expected completion of Phase 1 to December 31, 2005. The project is now in the mid of its seventh year since the project inception meeting in February 2003. Based on the original ProDoc timetable, the project had effectively three extensions of the closing dates: 31 December 2004, 31 December 2007 and 30 June 2010.

Its Mid-Term Review (MTR) was organized in September 2004 and an Interim Evaluation was conducted in February 2006 to determine to final status and preparedness to transition to Phase 2.

The 2004 MTR noted that Phase 1 was more of a capacity building phase which included a demonstration site (the MPOB-Guthrie experimental mill in Labu, Negeri Sembilan, as the first Full Scale Model (FSM)) while Phase 2 will be on replication of the completed FSMs. The Labu experimental mill has the potential power generation capacity of up to 2 MW, negotiated with MPOB during the project design and will serve to demonstrate the applicability of biomass energy technologies for the palm oil industry and for the private sector in general to appreciate. MTR highlighted issues on weak project performance where outputs and outcomes were largely affected by mainly management-related issues which have to be resolved first before the project can effectively address the barriers that it was intended to achieve as stated in the ProDoc. Areas for improvement include the role of NSC meeting as the venue for resolving project issues including inter-agency coordination and harmonization towards placing the use of biomass/biogas as a strategic policy and technical support to the country's renewable energy strategy and program. The role and interest of MPOB and the possible coordination route were there in terms of coordination work in the palm oil industry sub-sector. The CTA's technical advice, directions and inputs did not come in as expected by the BioGen Team. Among the recommendations of the MTR was strengthening the role of the CTA as the key in effective project management and coordination of expected outputs from among participating agencies. In retrospect, the FE observed that this was not effectively met by the project at the project level as seen in the frequent turnover of the CTAs and in some periods when the project did not have a CTA. At

the program level, the FE still sees the need for a central agency with specific mandate and organizational support to carry out a multi-sectoral BioGen program, particularly on the biomass/biogas technology demonstration and policy development and implementation.

The 2006 Interim Evaluation (IE) reported that, while key milestones were achieved such as completion of REPPA study, REBF financing models, tariff setting study and intense promotional efforts, the first FSM was still not installed as an important part of Phase 1. FE noted that the project was able to act accordingly on project extension, follow-through and full assistance to government in tariff setting, alternative financing mechanisms and filling project manpower complement. However, the FE observed that the following IE recommendations were not fully complied with: simplifying and fast tracking FSM hosting arrangements, strengthening the CTA's role, strengthening the network and organizational linkages among stakeholders, establishment of an M&E information exchange system and updating of the project plan and logical framework. The FE Team believes that these unfulfilled proposals remain necessary and should have been effectively acted upon to significantly contribute to project milestones. Investigation during FE found out that the various recommendations were unable to be implemented mainly due to continued negative industry perception, unstructured tariff setting, weak policy support mechanism and prolonged non-coordination among agencies.

Final Evaluation was organized in November to December 2010 and at this juncture, it aims to provide a comprehensive and systematic account of the performance of a project reaching its terminal date by assessing its project design, process of implementation, achievements vis-à-vis project objectives endorsed by the UNDP/GEF including any agreed changes in the objectives during project implementation, and any other results. Based on the assessment presented herewith, most of the outputs were already completed by Year 4 (July 1, 2006 to June 30, 2007) except outputs related to FSM progress in Component 4. While most outputs have successfully achieved, the outcome level achievements are yet to be realized.

The project is in its seventh year and the critical target is the completion and continuous operation of the full-scale model (FSM) projects for MHES Asia Sdn. Bhd. (MASB) and Felda Palm Industries (FPI). MASB has been completed, grid-connected and once attained its Commercial Operation Date (COD) on 15 Dec 2009 while the FSM in FPI has completed construction in March 2010 and as date ready for grid-connection. An interconnection facility template for embedded generation of less than 2000kW for very small renewable energy power (VSREP) was developed and awaiting to be finalized. The financial assistance for MASB, which was in the amount of RM 5 million, was disbursed to the project upon installation of the TNB meter in March 2009 and Initial Operation Date on July 2009. However, the MASB FSM was discontinued to operate because of technical issues such as revisions on the fuel feeding and its related systems that are still ongoing during the FE. It has not been operated again and therefore, without possible sales, MASB has not satisfied the financial arrangements with the financier, Bank Pembangunan Malaysia Berhad (BPMB).

FE noted that the ultimate cause of the Phase 1 delay was due to selection of suitable FSM site, which was brought initially by the inability of the experimental MPOB-Guthrie as the first FSM and this was exacerbated further by weak responses by private developers to enter such venture. Record shows that serious attempts in finding alternative FSM sites were constantly sought and it was not until two and a half years (2 1/2) later that MASB and FPI have successfully came into the picture. In essence, the delays affected the progress of the project as a whole especially in establishing critical milestones such as the suitable RE regulation, attractive /structured RE tariff and the development of a robust financing model needed for a biomass/biogas-based power generation projects. Up to the present, the two FSMs have still not been fully operational and they are expected to be fully completed in 2012 and may even stretch up to 2013 if the pending technical problems (including interconnection issues) faced delays during rectification process. For FPI, it is envisaged that

interconnection will be the only remaining hurdle while for MASB, major rework on fuel feeding systems are needed. FE noted that the full completion is beyond the authority of the project team as these are private-sector projects. It is however, expected that they will continue to complete the process and for MASB, it will be monitored under the normal banking regulation which repayments are being expected according to the loan covenants.

Given the uncertainties involved, the FE Team assessed as ***Moderately Unlikely*** on the sustainability of outcomes since the project has now ended. The GoM can come up with an alternate project plan with an updated logical framework (LFA) incorporating the BioGen valuable experience for another UNDP-GEF on biomass/biogas energy in GEF-5 on even with own government development budget.

Nevertheless, the continuing evidence of more biomass/biogas projects being proposed and approved in the last two years under SREP and CDM programs in which BioGen has also contributed into, is a proof that the project's medium to long-term goals are now coming into fruition. Directly or indirectly, the BioGen has also influenced short and long term consequences brought about by the project results as date. Hence, catalytic or replication effects cannot be ensured immediately if the FSM's operational experience will be used as basis by prospective companies in planning and deciding on biomass/biogas projects.

The significant achievements of the BioGen project include the successful setting up of the Renewable Energy Business Fund (REBF) as the demonstration of soft loan financing for RE projects in Malaysia. The project's assistance to the 1$^{st}$ FSM (MASB) on financing of the project was extensive and successful and resulted in the issuance of BPMB bank offer. The project team has successfully demonstrated its technical backstopping services needed and provided necessary management support in timely and efficient manner in ensuring the FSM progressed according to the plan. The biomass one-stop-center (BOSC) established during the project lifetime is timely and now ready to be emulated in the greater green technology sector.

The FE noted that UNDP Malaysia has been continuously monitoring the said project and in close discussion with the executing agency (MEGTW) in addressing the concerns especially during NSC meetings and time to time technical discussions. FE noted that GEF monitoring tools such as APR/PIR, quarterly reports, financial reporting and field visits are regular and have been adhered with.

The FE Team noted the effects of the project activities on strengthening the capacities of the MGTC, MEGTW and other related stakeholders and the palm oil industries in pursuing the project objectives. There is reason to believe, that the project has ***satisfactorily*** met the expectations based on the project results as discussed above. In terms of awareness raising, the Project's contribution to raise awareness about the use of palm oil biomass, palm oil mill effluent (POME) and RE as a whole is significant, as well as about the project's contribution to promote policy or advocacy activities and collaboration among stakeholders. The FE Team also noted that FELDA (holding company of FPI) is pursuing a company-wide program on replicating their FSM experience in their other POMs, and this alone is considered as one of the notable direct impacts of the BioGen project.

On the policy front, FE team noted the broad policies introduced in the 10 Malaysia Plan (2010 – 2015) where RE generation will be increased from less than 1% in 2009 to 5.5% of Malaysia's total electricity generated by 2015. It is expected that biomass and biogas will contribute up to 300MW and 100 MW generating capacity respectively. Further, RE projects announced in the Entry Point Projects (EPP) no 5 under the Economic Transformation Programme (ETP) 2010 proves that BioGen outputs are indeed able to be replicated and

adopted by the industries. EPP plans for more biogas plants to be developed over the next 10 years. Of these, 250 mills will target to supply electricity to the national grid by 2020 and another 233 mills will capture biogas to be used as fuel for their own boilers.

Overall, the BioGen Project is rated ***Marginally Satisfactory (MS)*** in achieving project outputs and outcomes. As the FE Team noted, the project outputs and outcomes tended to rely mainly on the natural government pace of tackling issues based on its priorities. While the project results did not come out at the time and level as expected in project design, they did become relevant to the development of biomass/biogas-based projects that eventually started to fall in place in the sixth and seventh years of the BioGen project implementation, much later that it has aimed for.

The GEF fund for this project is 99.9% spent with a balance of USD 14,103.00 remaining during the FE period. The total REBF allocation amounted to RM 28 million (USD 7.7 million) consisting of: a) GEF fund amounting to RM 9 million; b) AAIBE (MESITA) at RM 5 million; and, c) BPMB counterpart of RM 14 million. From the total allocation, RM 5 million (USD 1.3 million) was released for MHES Biomass FSM. FELDA Biogas FSM did not avail of the planned RM 9 million REBF. Thus, the remaining available REBF fund is RM 23 (including BPMB's RM 14 million and GEF's RM 9 million). GoM may decide on the future of the fund but FE would recommend that it continues to be consistent with similar project objectives. The amount of cash and in-kind co-financing exceeded the expected commitments stated in the ProDoc at 276%, including co-financing from cash contribution from 2 FSMs as investments by Host Companies (the total project cost for MHES was RM 80 million and for FELDA Biogas plant was RM 7.8 million).

In concluding, the following are seen in the FE:

a. Overall, BioGen was well-placed and integrated within the national government development strategies. It has achieved all other components' output except Component 4 (FSM demonstration).
b. The inputs and recommendations from BioGen were instrumental to the uplifting of more favorable tariff, better REPPA conditions as well as the ultimate preparation of RE policy strategies and RE Act.
c. Except for the completion of the two (2) FSMs, all expected outputs have been delivered in the first 4 years (2003 – 2007) of the project which was originally for two (2) years. Outputs for 2008 – 2009 are basically involved in the FSM commissioning (because original hosts did not materialize discussed as above) and outputs for 2010 are mostly monitoring of the completion of the installation and operation of the FSMs to be able to sell power to the grid as planned. In the PIRs, and validated during the FE process, there were project activities that were re-programmed for Phase 2. But since there will be no more Phase 2 for BioGen, those activities can be continued in another project and/or be absorbed by a new designated government agency if FSM replication is desired.
d. The basic policies and a pending enactment of the RE Law and applicable tariffs have been achieved which consist the most important achievements attributable to the project. Currently, the RE industry enjoys a higher tariff of RM 0.21/kWh as it clamored for. The RE Law (including the proposed Feed-in Tariff Mechanism) which is expected to be passed by parliament in the second quarter of 2011 will further provide the needed institutional, financial and other important supports.
e. There is still the lack of an agency which is authorized to integrate the various activities in biomass/biogas (and RE in general) and take leadership role in pursuing the program management and linking all the outputs of the project and all other related projects and activities into the desired RE outcomes consistent with GoM

goals and priorities.

f. It appears that the project has not completed documenting an M&E system to be followed in linking Outputs to Outcomes using a system which is established and documented in a computer-network-based platform. A concrete real-time monitoring plan on RE is absent which leads to data gathering organized in ad hoc level and preparation of the said reporting requirements of UNDP and GEF become difficult and oftentimes present inconsistent and unclear basis of monitoring results and tracking progress including policy effectiveness. Documentation submitted to FE is mainly on the overall SREP development circle and how it is interlinked to the overall national policies and the role of SCORE (and the future RE industry with the presence of RE Act) but the said monitoring plan is yet to be seen although it was noted that such initiative will be developed further in the 10MP.
g. It appears that there is lesson learnt in organizational, management arrangement and leadership role during project implementation especially in tackling the challenges which have affected the project performance.
h. FE concurs with the project team's decision for closing down the project in December 2010 even the FSMs have yet to be fully completed as further delays will lead to ineffective supervision and will expose the BioGen project to unforeseen risks and uncertainties. Factors towards the FSM completion are no longer beyond the team's capability as they are mainly technical which is specific to the plant operation.
i. As at date, the biomass FSM (MASB) only operated for 15 days (in Dec 2009) due to the problem in its fuel handling systems and furnace stability. The biogas FSM has been in better situation and has been operating and delivering 300 KW with sufficient gas to support the designed 500kw but needs to upsize the interconnection cable to fully achieve its goals.
j. The overall assessment rating of the project is ***Marginally Satisfactory (MS).***

The FE Team recommends the following:

1. Continue implementing remaining project activities towards achieving desired outputs/ outcomes *which includes updating of the need and relevance considering current GoM policy thrusts and goals and to integrate them with new necessary activities in the context of a program and strengthened organizational structure*. A new LFA expected.
2. Remaining project activities (the completion of the FSM and its M&E components) and/or deliverables to be rectified or improved in order to bolster the realization of project outcomes. *This includes the continuation of the task that the project has started especially in overseeing the development, implementation, monitoring, evaluating, facilitating and tracking biomass/biogas and other RE projects by an authorized agency in coordination and work harmonization in Malaysia.* A strategic review of the appropriateness of PTM as prescribed in the BioGen ProDoc (now the Malaysia Green Technology Corporation) to perform this role is further recommended as the said task may not be compatible with the MGTC's current thrusts. *Integration of the database systems existing in different authorities and agencies involved in biomass/biogas (or RE in general) is foreseen including instituting effective M&E system for data gathering (with performance update) including appropriate institutional and budgetary supports to sustain it.*
3. Follow-up activities that will be carried after the project includes the below:
   a. Strengthening *coordination with all stakeholders especially in determining the realistic share of biomass/biogas in the Malaysia's energy mix and its implementation status* of the 10MP and ETP projects.
   b. *Continued validating of the technical design and improvements on the two FSMs and the corresponding financial feasibility of the proposed improvements considering operating experience would be beneficial lesson learnt for the other RE plants.*
   c. Finding *an effective EFB reference price based on fuel parity and non-energy usage to arrive at a certain reasonable margin as a fuel shift incentive.*

d. *Utilization of the remaining REBF funds should look into the original purpose for which it was intended to serve*, e.g. an innovative loan/grant mechanism and facility that will be worked through (or revolved) within the Malaysian banking sector to soften the risks involved in the biomass/biogas-power generation technologies. Since the BioGen Project has physically closed in December 2010, this REBF will be under the auspices of the GoM under MEGTW, or when feasible, through the newly designated authority to oversee the biomass/biogas projects, under a broader RE program. Reference to 10MP or to 11MP shall be closely linked.

The lessons learnt and derived from the BioGen experience are as follows:

1. The needs of an overarching RE program are crucial during the project implementation. With a stronger final objective the project partners can exert more efforts, individually and collectively especially in strengthening inter-agencies coordination under a more strategic partnership arrangement in achieving common project goals and executing agreed plans in the ProDoc.

2. Official MOAs that define more specific project management arrangements are necessary to implement the project more effectively and derive sustained commitment in achieving outputs that are clearly linked to the project's desired medium to long-term outcomes.

3. In managing project of this size, combining the roles of the CTA and the overall Project Manager into one person may not be effective in performing the critical functions of project management and provision of technical advice at the same time. Project manager's role shall include managing day-to-day project progress including inter-agencies coordination and while a CTA shall look into the FSM completion, power generation and interconnection issues.

4. Site selection was critical in determining the project overall performance. The period of construction and commissioning including adhering to the local regulation and proximity to grid and supply stability of fuel sources should be considered fully during project design.

5. A formal M&E system linking project outputs to outcomes lodged in a computer-networking platform among participating institutions and agencies and supported with an active M&E policy, budget and organizational arrangements is very important in achieving the long-term national and global goals for which a UNDP-GEF project is always designed and approved to be implemented.

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**(BioGen) Project – Phase I**

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**(Draft) FINAL EVALUATION REPORT**

# 1. INTRODUCTION

This report is being submitted in connection with the Final Evaluation (FE) of the project: **Malaysia: Biomass-based Power Generation and Cogeneration in the Palm Oil Industry**
**Project – Phase I, or** otherwise referred to also with its short title as the **BioGen Project**.

The mission and data gathering for the FE was conducted from October 7 to October 16, 2010. The FE process as part of the monitoring and evaluation system for United Nations Development Programme (UNDP)/GEF projects was conducted by the FE Team composed of Mr. Rogelio Z, Aldover, the International Consultant and Mr. Soon Hun-Yang, the National Consultant in cooperation with Mr. Ghazali Talib as Team Coordinator. For documents and other information requirement, the FE Team was assisted by the remaining staff of BioGen, namely, Nor Azaliza Damiri (Research Officer), Saharudin Savee (Finance Officer) and Haniff Ngadi (Technical Assistant).

The FE process is in accordance with the Terms of Reference (ToR) as shown in **Annex A** and conducted in close coordination with the BioGen Project Team, selected stakeholders and the UNDP Malaysia Country Office, through Mr. Asfaazam Kasbani, the Assistant Resident Representative (Environment and Energy).

The BioGen Project is a GEF Operational Program (OP)-6 project, implemented by UNDP Malaysia and nationally-executed by the Malaysia Green Technology Corporation (MGTC – previously known as Pusat Tenaga Malaysia (PTM) on behalf of the Ministry of Energy, Green Technology and Water (MEGTW – formerly the Ministry of Energy, Communications and Multimedia (MECM)). A Memorandum of Understanding was undertaken between MGTC (used in this report to refer to the original PTM which implemented the BioGen Project) and the Malaysian Palm Oil Board (MPOB) to cover the palm oil industry inputs and technology demonstration aspects of the project.

## 1.1. Purpose of the Evaluation

This FE aims to provide a comprehensive and systematic account of the performance of a completed project by assessing its project design, process of implementation, achievements vis-à-vis project objectives endorsed by the GEF including any agreed changes in the objectives during project implementation, and any other results.

## 1.2. Scope of the Evaluation

As stated in the ToR, the scope of work for the FE includes, but not necessarily be limited to, the following activities: assessment of progress in project implementation, assessment of project outputs and assessment of project impacts. For practical reasons and considering the project timeframe, the assessment of short-to-medium term project outcomes was the focus of evaluation and provided comments on the means of assessing the monitoring for long-term impacts.

The scope of evaluation covered GEF-supported activities and the co-financed activities on the component and project levels.

### 1.3. Approach and Methodology

The FE Team reviewed relevant project documents and reports related to the planned evaluation. It discussed with the National Project Director (NPD) on topics and issues that relate to the implementation and impact of the project. Detailed discussions were also conducted with the remaining PMO staff and several past Chief Technical Advisors (CTAs) regarding historical developments, institutional and management mechanisms and implementing experience in the project activities.

The FE Team also met with various stakeholders and conducted group discussions during the evaluation mission. The list of attendees and respondents in the data gathering process is in **Annex B** and the FE Schedule in **Table B-1**.

Site visits to the project's FSM demonstration sites were also conducted to assess project accomplishments at the local level. Data gathering and interviews with local implementers on project operations and management were conducted. The FSM sites visited are: (1.) Biomass FSM at the MHES Asia Sdn Bhd. (MASB), located at Bahau, Negeri Sembilan, with a power plant capacity of 13 MW, and (2) Biogas FSM at the Felda Palm Industries Sdn Bhd (FPISB), located at Jempol, Negeri Sembilan with a power plant capacity of 500 kW.

The FE process followed the GEF Monitoring and Evaluation Policy, Minimum Requirement No. 3 published in 2008 and the norms and standards required by the UNDP as indicated in the Terms of Reference for the evaluation task. The highlight of excerpts from the guidelines is in **Annex C**.

The list of documents provided to the FE Team and used as reference for this evaluation is in **Annex D**.

In assessing project results, the FE sought to determine the extent of achievement and shortcomings in reaching project objectives as stated in the project document, and indicated if there were any changes and whether those changes were approved. In assessing project performance, the FE Team focused on achievements in terms of outcomes. Performance ratings were also provided using the GEF Monitoring and Evaluation Policy guidelines.

The recommendations of the Mid-Term Review (MTR) in 2004 and the Interim Evaluation in 2006 were referred to in the FE process and were likewise reviewed to determine whether these were considered and implemented by the BioGen Project. An assessment was done on what were the effects of the implementation or non-implementation of said recommendations on the overall performance of the project.

The following schedule served as guide in conducting the evaluation:

- Document Gathering and Preparation for Contract Final Evaluation (October 1-5)
- Arrival of FE Consultant (October 6)
- Inception and Work Plan Meeting (October 7)
- Data gathering on Project Accomplishment of Output and Outcomes and Financial Performance (October 7 to 14)

- Interviews with Relevant Stakeholders (October 7 to 14) - Schedule
- Field Visits (October 12 - 13) - Schedule
- Presentation of Initial FE findings , recommendations and comments from PMU and UNDP (October 15)
- Submission of Draft FE Report incorporating comments provided during the presentation (October 24)
- Review and submission of comments by BioGen PMO and UNDP Kuala Lumpur (October 25 – 31)
- Finalization and Submission of Final Review Report (November 5)

## 2. THE BIOGEN PROJECT AND ITS DEVELOPMENT CONTEXT

While the palm oil industry contributes significantly to the country's Gross Domestic Product (GDP), it also accounts for the largest biomass waste production in Malaysia. The two most abundant types of these industry residues of interest are the palm's biomass residues and the Palm Oil Mill Effluent (POME). These are easily available in large quantities and require cost effective means of disposal. They are either mostly incinerated and dumped or sparingly used as fuel for the mills' heat and power requirements in a very inefficient manner.

During the project design which started in 1999, the biomass can have a total potential capacity of 365 MW while POME can have 177 MW, which are steadily growing with more palm oil plantations up to present times.

The empty fruit bunches (EFBs) constitute 23 %, while the POME, 67%, of the fresh fruit bunches (FFB) by weight. Aside from their energy value, the EFB can be used for soil mulching while POME can be used as soil enricher.

Depending on the extent the EFBs are used as fuel and whether POME-derived biogas is also used or not, the potential power generation capacity from the palm oil industry by year 2005 would range from 270 MW to 665 MW. This information was derived from the BioGen ProDoc. A 270 MW capacity is possible if only all of the mesocarp fibers and shells are used. The excess power generation in this case will account for 1.4% of the total national electricity production. If say 25% of the available EFBs is also used, a total of 312 MW of power generation capacity can be expected, with the excess power generation accounting for 1.8% of the national electricity production (3.8% if POME-biogas is also used). The maximum capacity can be achieved if all EFBs, fibers and shells are used as fuel for power generation/CHP including all the available POME-derived biogas. The excess power generation from the palm oil industry in this case will account for 5% of the national electricity production in 2005.

In terms of technologies, since the palm oil mills (POMs) have abundant biomass waste resources (mainly in empty fruit bunches (EFB); their energy systems were designed to be cheap rather than efficient. Most of the existing biomass combustion systems in Malaysia utilize low efficiency low-pressure boilers. The average conversion efficiencies in process steam and electricity generation are 35% and 3%, respectively. The average overall cogeneration efficiency is 38%.

An additional source of energy in palm oil mills is the biogas produced in the anaerobic decomposition (for wastewater treatment purposes) of POME. During the project design stage, POME-derived biogas is not recovered and used. This $CH_4$-rich (65%) gas is just allowed to dissipate freely into the atmosphere.

Commercially proven technologies are available in the international market for efficient production of power and heat from major biomass resources. The state-of-the-art modern

technologies utilize efficient high- pressure boilers. Some of these boilers are capable of dual fuel burning, utilizing either liquid (e.g., diesel oil) or gas (e.g., natural gas) fuel as supplementary energy source. Dual fired boilers will be used in palm oil waste-fired boilers to facilitate the use of POME-derived biogas as supplementary fuel.

Local manufacturing capacity of efficient high-pressure steam generators for power generation in the POM in Malaysia was low during project design. Fabrication will be made locally but most of the equipment for a biomass-based power generation and CHP are designed overseas and have to be imported. Assistance (technical and/or financial) to local steam and power generation equipment manufacturers to encourage them to improve designs and manufacturing methods has been provided by another UNDP-GEF funded Malaysia Industrial Energy Efficiency Improvement Project (MIEEIP) as they are utilizing almost the similar types of equipment..

As to the biogas produced during POME treatment, there are no government regulations yet requiring POMs to prevent its release to the atmosphere. In case of its recovery and energy use, the biogas can be piped from the anaerobic digestion tanks and POME lagoons/ponds and collected in a central storage tank. When properly treated to remove the corrosive components and with fuel gas reticulation systems, biogas from POME can be useful industrial on-site fuel.

The idea of biomass-based power generation and CHP for selling electricity to the grid or other electricity consumers has been well accepted. However, during project design, various technical, information, financial, institutional and regulatory barriers surfaced out hindering its development. At the outset, there was no experience with efficient biomass power generation/CHP systems that sell surplus power to the grid or that sell electricity and/or steam to another facility under a power purchase contract.

Being a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), Malaysia has exercised its rights to avail of the incremental cost funding provided by the GEF for national projects that will bring about global environmental benefits like the BioGen Project. Since BioGen is a capacity building and technical assistance project, the Government of Malaysia (GoM) has approached the UNDP, which is an implementing agency of the GEF. The GoM acknowledges the UNDP's comparative advantage in these areas as UNDP has been working and cooperating closely in implementing activities geared towards sustainable development in Malaysia

### 2.1. Goal and Objectives

Based on the foregoing premises, the BioGen Project was conceived and approved to have the development goal related to an environment-cum-energy nexus with assistance from the GEF and UNDP as follows:

**Development Objective**:

Reduction of the growth rate of GHG emissions from fossil fuel fired activities and from the decomposition of unused biomass waste through the removal of the major barriers to the development of biomass-based CHP projects to supplant part of the current fossil fuel electricity generation in Malaysia.

**Major Outcome Indicators**:

*Phase 1*: About 15% of the POMs in the country have initiated plans to implement biomass-based power generation/CHP by end Year 2.

*Phase 2*: The GHG emissions from power generation in Malaysia are reduced by 3.8% by end of Year 5 compared to when no interventions are implemented.

The project was approved for Phase 1 implementation with the understanding that Phase 2 can only proceed upon successful completion of Phase 1 (as reflected in the FE of Phase 1).

### 2.2. Project Formulation

The project strategy involved the implementation of barrier-removal activities, including the implementation of demonstration schemes showcasing the implementation of biomass-based grid connected power generation and CHP in Malaysia as FSMs. The various project components were designed specifically to address the identified barriers to biomass-based grid connected power generation and CHP in Malaysia. The project is expected to draw and build on the existing capacity already available in Malaysia. The combined effect of the activities in all project components is expected to "jump-start" biomass-based power generation/cogeneration in the country.

The project was designed and approved to be implemented in two phases**.** Phase 1 will begin with activities that are considered capacity building and technical assistance focusing on the removal of primary barriers that hinder the widespread application of biomass-based power generation/cogeneration using both biomass and biogas sources. This phase had to involve extensive capacity building activities using GEF resources and co-financing funds. Also in this phase, a demonstration scheme had to be carried out in an existing small experimental POM (2MW capacity).

Upon successful completion of Phase 1, Phase 2 would have included the implementation of an innovative loan/grant mechanism that will be worked through the Malaysian banking sector, particularly the Bank Pembangunan Malaysia Berhad (BPMB). The GEF funds will be used to support a risk guarantee mechanism for 3 additional demonstration sites with higher power generation capacity than the experimental mill, each with a different mix of parameters that make them a special case, demonstrating the technical viability of new and retrofitted technologies. The combination will consist of mills with and without plantations and with new or retrofitted technologies that may or may not have any connection to the grid.

There are five (5) components of BioGen Phase 1 and their corresponding immediate objectives and success indicators as follows:

| Component/Immediate Objective | Success Indicator |
|---|---|
| **Component 1: Biomass Information Services and Awareness Enhancement Program**<br>Provide adequate, affordable, accessible and up-to-date information services, continuing education, and awareness improvement on the application of biomass energy resources to prospective biomass energy users and technology developers/suppliers. | A sustainable and continuously evolving program of providing biomass energy technology information services, continuing education, and awareness enhancement, covering the energy applications of biomass and biomass-derived fuels, particularly biogas is established & implemented after Year 1. |
| **Component 2: Biomass Policy Study and Institutional Capacity Building**<br>Strengthen and improve the policy and regulatory framework to encourage feasible biomass-based grid-connected power | A clear government policy and accompanying implementing rules and regulations on the utilization of biomass energy for power generation is established by Year 1. |

| | |
|---|---|
| generation and cogeneration projects. | |
| **Component 3: Biomass Initiatives Financing Assistance Program**<br>Encourage the government, private sector and the financial community to provide financial assistance to the development and implementation of biomass-based power generation/cogeneration projects. | Financing assistance programs for biomass energy technology applications are established and availed of by project developers, and the financing and banking sectors are providing financing for biomass-based power generation and/or cogeneration projects by Year 2. |
| **Component 4: Biomass-Based Power Generation Demonstration**<br>a. Facilitate the effective demonstration of the techno-economic viability, design, development, financing and sustainable operation & maintenance of biomass-based grid connected power generation/CHP projects.<br>b. Demonstrate the techno-economic viability, design, development, financing and sustainable operation and maintenance of biomass-based grid connected power generation/CHP. | a. Techno-economic feasibility of biomass-based power generation/CHP in suitable POMs, including the necessary implementation requirements from the GoM, TNB and biomass waste suppliers established by mid-Year 1.<br><br>b. MPOB-Guthrie operating as an efficient and viable grid-connected biomass power generation plant using palm oil solid waste and POME-derived biogas by end Year 2. |
| **Component 5: Biomass Energy Technology Development Program**<br>Establish the potentials and requirements for the energy applications of biomass, as well as the support provisions for such initiatives. | Assessment of the needs and potentials for energy and non-energy uses of biomass resources are completed and provisions for support are in place completed by end Year 2. |

As the ProDoc stated, the description of Phase 2 activities has been included to provide information on the context of the larger project. However, the financial commitment under this project is only limited to Phase 1 activities. It was emphasized that Phase 2 activities have not yet been approved nor committed by UNDP-GEF as the approval of the BioGen Phase 2 was subject to successful implementation of Phase 1 and availability of GEF resources. BioGen Phase 1 received GEF funds amounting to USD 4 million and a Co-financing fund total of USD 10,734,190, or total project cost of USD 14,734,190.

| **Summary of Project Inputs (in US$)** | |
|---|---|
| **UNDP/GEF** | **4,000,000** |
| **CO-FINANCING** | |
| Government (in cash): | 3,025,600 |
| Government (in kind): | 804,820 |
| Private Sector (in cash): | 6,518,500 |
| Private Sector (in kind): | 385,270 |
| **Total Co-Financing** | **10,734,190** |
| **TOTAL** | **14,734,190** |

## 3. PROJECT ORGANIZATION AND MANAGEMENT ARRANGEMENTS AND RELATED FE OBSERVATIONS

### 3.1. Project Organization and Management Arrangements

The BioGen Project was organized among the following institutions and groups and their expected benefits from this palm oil biomass utilization and application project:

- Government institutions such as MECM (now MEGTW), Economic Planning Unit (EPU), Ministry of Science, Technology & Innovation (MOSTI), Ministry of Primary Industries (MPI – now is Ministry of Plantation and Commodities (MPIC)), Jabatan Bekalan Gas Malaysia(JBEG – now Energy Commission), and Ministry of Finance (MoF) - knowledge and experience in formulating necessary policies on the development and application of RE.

- Malaysia Energy Centre (PTM, now MGTC) - strengthen and complement PTM's activities in promoting RE and will bring about significant capacity building of its newly-established technology division.

- Participating research and development (R&D) organizations particularly MPOB, Standards and Industrial Research Institute of Malaysia (SIRIM), Forest Research Institute Malaysia (FRIM) and universities - enhancement of their research and consultancy capabilities

- Host demonstration POMs and RE developers - access to funds, knowledge and implementation of proven environmentally sound biomass-based grid-connected power systems

- Local boiler manufacturers - improved engineering design and processes in local biomass boiler manufacturing.

- Power system equipment suppliers - market for suppliers of power system equipment such as turbines, burners and others.

- Energy Service Industries (ESIs)/Engineering Consulting firms - opportunities for the involvement as consultants, suppliers and contractors

- Palm Oil Millers Association (POMA) and the Malaysian Palm Oil Association (MPOA) - complement their role in promoting awareness of RE technology and its applications among its members.

- Financial and banking institutions - appreciation of the economic benefits of RE projects and future biomass-based grid-connected power generation projects

The BioGen overall project management organization as implemented is illustrated in the following organigram (**Fig. 1**) showing also the project partners and their involvement in the different project components:

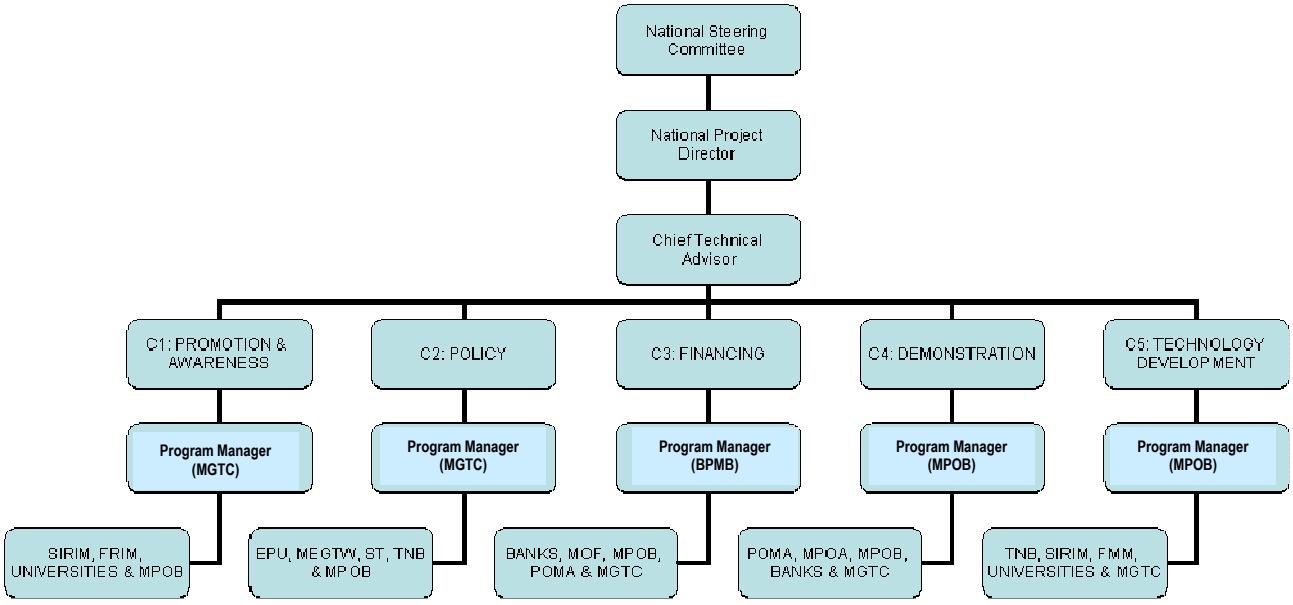


**Fig. 1: BioGen Project Organization**

The organizational strategy was to locate the institutional focus within PTM or which is now MGTC. Thus, it should be noted that in this report, MGTC will be used to refer to what was also the PTM before. In addition to having MGTC at the core of activities, BioGen will have to sufficiently involve other stakeholders, particularly MPOB, such that the project receives the support of all concerned and develops collective institutional capacity. The comprehensive strategy would have to be used for project design and implementation where multiple intervention techniques would have been implemented in a carefully orchestrated sequence focused on a single program on development of biomass-based power generation for maximum impact. The activities were planned to include policy studies, creation of biomass database, demonstration programs as well as the provision of financial incentives, technology development, training courses and dissemination activities in an integrated manner.

As stated in the ProDoc, the project management arrangement with participating agencies is more toward providing assistance to each of the project component toward delivering the expected outcomes. Overall responsibility for project implementation and policy direction lies with the MEGTW. Coordination and policy harmonization among government agencies are achieved through a NSC chaired by the Secretary General of MEGTW meeting every quarter or on a special meeting when necessary. The executing agency is MGTC and its Chief Executive Officer (CEO) serves as the NPD. The NPD carries out the directions and decisions of the NSC and is also responsible for the monitoring and adherence of the approved annual work plan forming the basis of the project execution.

The NSC provided the necessary guidance and oversight to the project implementation and coordinates activities with other government agencies and relevant organizations at the policy level. The NSC also acted as a discussion forum and approval body for proposed activities, policies and initiatives. The NSC also served to oversee the activities of the demonstration and support programs to ensure that they adequately incorporate efficient technologies and corresponding funding. The membership of the NSC included the government agencies (EPU, MEGTW, Energy Commission (EC) or Suruhanjaya Tenaga (ST), Ministry of Natural Resources and Environment (MNRE), Malaysian Industrial Development Authority (MIDA), Ministry of Plantation Industries and

Commodities (MPIC), FRIM, MPOB), implementing agency (MGTC), industry association (MPOA), private sector organizations (TNB, SIRIM, Independent power producers (IPPs), non-governmental organization (NGO) Centre for Environment, Technology & Development, Malaysia (CETDEM), universities (Universiti Teknologi Malaysia (UTM), Universiti Sains Malaysia (USM), Universiti Kebangsaan Malaysia (UKM)) and UNDP, as represented.

With the purpose of being more effective, the scope of project management and implementation responsibility was shared. MGTC is responsible for Components 1 and 2, BPMB for Component 3 and MPOB for Components 4 and 5. Experienced officers were to act as Program Managers (PMs) from these primary support agencies in their assigned component(s) for the day-to-day operations.

The project implementation is being monitored and evaluated in line with UNDP rules and procedures and the GEF guidelines for monitoring and evaluation (M&E). UNDP undertakes this activity with cooperation from the GEF focal point in Malaysia and the MEGTW/MGTC, as project's executing agency.

In terms of project management, coordination and operational matters, periodic project management meetings (monthly / bi-weekly) between the CTA and the PMs are held to discuss project management and implementation issues and the interlinks among the five project components. The FE Team noted the absence of an overall Project Manager in the Project Organization. In effect the CTA doubles to function also as the Project Manager. The Project Manager position was not included in the BioGen ProDoc/Design, and it is assumed that the CTA will take the project management role as practiced also in a previous UNDP project.

**Observations regarding actual project management arrangements as implemented**

In regards to the project operations, the following were observed by the FE Team regarding project management arrangements:

a. The project was found to have sufficient project management arrangements and has relied on the organizational strength of PTM (now MGTC) which has been implementing many national and international projects. While the general organizational arrangements were described in the ProDoc and assumed during project implementation, the FE Team noted that, except between PTM and MPOB, there were no specific TOR, Memorandum of Agreement (MoA), or detailed agreements on plans were developed for the other participating agencies to define the arrangements more specifically as updated and committed description of resources, outputs and timelines vis-à-vis those promised during the project development stage in 2002. The management arrangement among the participating government agencies were only coordinated through the National Steering Committee (NSC) which meets every six months.

b. To attain the project objective, three of the five components during early stage of the project implementation (Components 3, 4 and 5) were assisted by MPOB and BPMB through secondment of staff but after two years, this arrangement was stopped due to no major progress starting Year 4, particularly on the FSM implementation for which these agencies were assigned. Their participation was limited to only providing assistance whenever and wherever necessary.

c. In June 2004, a Logical Framework Analysis (LFA) updating was done to retrofit the project planning matrix (PPM) as one of the adaptive management approaches that was done by the BioGen Project Team. This was accompanied

by the subsequent adjustments of the Annual Targets. The updated set of indicators and targets were first used in the PIR 2005 reporting exercise. These changes served to clarify the expected outputs of the updated activities. The FE Team observed that this adaptive management was effective. However, the FE Team observed that subsequent PIRs did not use anymore the complete updated PPM indicators and targets due to some changes in the PIR format.

d. As mentioned in the midterm review, it was recommended to "emphasize that the CTA should perform the critical combined roles of project management and provision of technical advice because of the absence of an overall Project Manager in the project organization. This is because the NPD as top executive of the MGTC would have to attend to high level management matters, and therefore, the CTA should double also as the overall Project Manager to attend to day-to-day operation and management requirement of the BioGen Project to attain project objectives particularly for the critical four (4) FSMs. There was a long period when there was no CTA which have impacted on the execution of the project.

e. Based on the ProDoc's organizational design to develop the FSM sub-projects, the FSM Program Team was expected to draw from their own agencies the expertise to become the owner-engineer for the FSM installation in order to ensure that the FSMs will serve the Project's objectives. However, as it was implemented, the FSM Program Team only played a less-active role of facilitator, i.e. to assist the FSM Host in (a) the selection of contractors and suppliers, (b) preparing the financial model for the purpose of Small Renewable Energy Program (SREP) and loan application, (c) Renewable Energy Power Purchase Agreement (REPPA) negotiation, and (d) obtaining permits and licenses, and to supervise the construction of the FSM, and other similar assistance tasks. This situation has affected the implementation of the FSM program of the project in timely and effectively meeting its objectives. The actual FSM process has relied solely on Host's own timetable and priorities.

f. Changes in the planned management arrangements were also decided for the purpose of focusing on expediting the FSM implementation. A new CTA was appointed in February 2005. In order to catch-up on all the delays and respond to the Mid-Term Review. In 2005 to 2006, the five (5) project components were merged into three (3) focus areas which are FSM development, REPPA and REBF. Some activities that were not directly related to FSM implementation were deferred. This deferment of some activities resulted in a reallocation of the budget of the deferred activities into the FSM requirements. The proposed deferment was presented at the 5th NSC meeting on 21 March 2005, and was endorsed by the NSC. A change of project approach (as contained in the "Immediate Action Plan") was introduced in response to the recommendation from the Mid Term Review. The consulting firm, Perunding AME Sdn Bhd., was appointed to be the FSM consultant (also as owner-engineer) to expedite the development of FSM at the same time act as the consultant to assist in the other project components' outputs. The tasks were scheduled for 20 months or up to the date of commissioning and hand-over of the FSM projects. The idea was to use the FSM completion as the final success indicator to support the progress of other components. For the REBF, since the GEF funds are dedicated for the incremental biogas demonstration projects, it was decided that the rest of the contributions (from MESITA and BPMB) will be used to fund other RE sources so as to increase and encourage other RE players to participate. The FE Team was informed that near-completion activities such as the REPPA preparation, policy studies and financing model studies were carried out in-house using internal

expertise as in-kind contribution to the project.

Such activities were justified to be more efficiently and effectively carried out by the project team themselves while the Perunding AME focused on technical development and FSM completion. This decision was endorsed and approved during the 5th NSC Meeting.

Onwards up to 2008, the project was headed again by a new CTA / Project Coordinator to put the project arrangement back to original arrangements. The project, however, continued to be implemented without experienced Component PMs from the respective support agencies i.e., MPOB and BPMB.

g. To sustain the project outcomes, the Biomass One Stop Centre (BOSC) which was set up by the BioGen and housed at the MGTC continues to provide advisory on project feasibility, policy, energy resources, and other support services to interested project proponents in the industry.

h. In monitoring the activities of the project, the BioGen Project Team mainly involved in regular meetings and discussions about the progress of the activities and resolving issues as they come. Such arrangement served the operational and organizational aspects of implementation. The FE Team noted that while this practice is important, there is also a need to establish a formal monitoring and evaluation system set up by BioGen to monitor the achievement of desired outcomes resulting from project activities and outputs, e.g. number of POMs initiating biomass-based energy projects in Malaysia, and other outcome/impact metrics and performance indicators suggested and approved in the ProDoc. This is discussed in more detail in **Section 4.3**. It appears that such project management arrangement is found to be inadequate in documenting the M&E system to be followed in linking Outputs to Outcomes. When such a system is established and documented in a computer-network-based platform, the project monitoring and data gathering about project achievements would have been installed among participating institutions and agencies under an adopted M&E policy with appropriate institutional supports to sustain it. As such, the monitoring and evaluation function of the project will not be affected by staff turnovers and can be institutionalized and sustained in an appropriate regular government agency designated to oversee the program after the project ends.

The FE Team further noted, however, the existence of RE projects monitoring in general (that could also include biomass-based projects) via the SREP under the EC as assisted by an inter-agency committee, the Special Committee on Renewable Energy (SCORE) which was set up to cater to projects applying for SREP. Other means of monitoring are through the application process under the Clean Development Mechanism (CDM) program by the Ministry of Natural Resources and Environment (MNRE). Almost all of the BioGen projects applied for CDM. As it is, there is the lack of a dedicated central agency to monitor and evaluate the deployment of biomass-based projects being pursued by BioGen. The need to monitor and evaluate related activities and programs is underscored by the targets mentioned in the Malaysian RE Policy (**Annex E**): from 2011, the cumulative RE Capacity of 217 MW, share RE in energy mix at 1 % and Annual CO2 Avoidance of 773,325 tonnes will grow to 2020 targets at 2,065 MW, 9% and 7,073,199, respectively. Said targets are also planned to be translated from national to regional levels which calls for more active and progressive participation from the state and local level players.

i. The Annual Project Report/Project Implementation Review (APR/PIR), Annual

work Program (AWP), Financial Plans, quarterly reporting and financial reviews have aided management, implementation and administrative requirements to some extent. Synchronization to the ATLAS format however needs further strengthening as the project team was not well versed in understanding the APR/PIR template. The team mainly relied on UNDP Programme Manager to assist in them in complying with the UNDP/GEF forms.

j. The use of electronic information and communication technologies has not been optimized to effectively help in the implementation and management of the project. The system will become more relevant and effective for project management purposes if the different databases are integrated and more data are placed in the databases and shared among the stakeholders to aid in policy and decision making.

k. It appears that the organizational arrangement and leadership role can be strengthened further to influence proper project management in pursuing barrier removal strategies especially when the project was experiencing major challenges which had significantly affected the project performance during the extended period of the project. These challenges though were not within the direct control of the project.

l. The frequent changes of key personnel such as the CTA (5 changes) and Component Managers inevitably affected the overall implementation direction and moral of the staff involved.

m. The ultimate cause of the Phase 1 delay was difficulty in selecting a suitable FSM site, which was caused initially by the inability of the experimental MPOB-Guthrie to stand as the first FSM. This initial setback was exacerbated further by weak responses by private developers to host the demonstration with the terms and conditions set by the project. The project activity records show that serious attempts in finding alternative FSM sites were made in many occasions and it was not until two and a half years (2 1/2) later that MASB and FPI came into the picture by agreeing to become host demonstration companies.

n. Weak coordination arrangements and continued negative perception on RE-based power generation in the private sectors have contributed to ineffective cooperation and resulted in delays or non-delivery of desired outputs.

### 3.2. Other Project services contracted out and management arrangements contributing to the project results

There were major activities and sub-components contracted out to co-operating agencies and service providers.

| Activities Contracted Out | Contractor | Arrangement | Overall Results |
|---|---|---|---|
| Component 1 | | | |
| BioGen web portal and BRIS | Web hosting company (Obiz Solution) | All maintenance and administration will be done by web hosting company for 1 year, thereafter upon project closing the operation and maintenance will be | Satisfactorily completed and used |

| Activities Contracted Out | Contractor | Arrangement | Overall Results |
|---|---|---|---|
| | | handed over to MGTC. | |
| Study on biomass resources inventory in the country and identification of its energy potential | SIRIM | As project partner, SIRIM provided services | Satisfactorily completed and used |
| Development of a RE curriculum for universities | UKM Pakarunding Sdn Bhd | Provided services as a service provider/contractor | Satisfactorily completed and used |
| Component 2 | | | |
| Study on REPPA | Zaid Ibrahim & Co | Provided services as a service provider/contractor | Satisfactorily completed and used |
| RE policy paper | Consultant (Dr. Ismail Mustapha) | Provided services as a service provider/contractor | Satisfactorily completed and used |
| **Activities done in-house** | | | |
| Component 1 | | | |
| Rating Scheme for Biomass based Companies | MGTC/MPOB | Supposed to be developed by international consultant and to provide the necessary technical assistance to MGTC. Done by MGTC with strong support by MPOB | Completed with modification. Rating scheme was not implemented due to the sensitivity of data presented in the scheme which will reveal the business performance of each POM. An alternative study on baseline of biomass residue and energy utilization to 100 POMs was rather implemented. |
| Component 2 | | | |
| Biomass policy analysis and pricing study | MGTC | In-house MGTC study | Satisfactorily completed |
| RE Electricity Pricing Study | | To resolve the “level playing field” issue concerning the pricing of, and off-take requirements for, RE electricity from the biomass based power generation had also be covered by the project team. | Satisfactorily completed |

In general, the outputs of these activities and sub-components contracted out to co-operating agencies and service providers were of satisfactory quality and were very

useful for the project.

The FE Team noted some details relevant to the process of establishing the desired tariff that could be favorable to biomass/biogas projects. The process took a long time and contributed to the delay of project results. As mentioned earlier, this is outside the direct control of the project. For the RE Electricity Pricing Study, the papers / proposals were submitted to MEGTW for consideration and action which include study on the "Cost Structure And Selling Price" of electricity for small RE power plants was conducted in 2003 to determine the cost structure and unit cost of the electricity, to determine the financial viability of RE resources and to recommend the energy selling price. Three options proposed for the pricing mechanisms: 1) cost-based pricing, 2) average cost pricing plus predetermined rate of return and 3) flexi-pricing for RE electricity sales based on market conditions. Bargaining in the selling price of energy is within the range of RM 0.20 to 0.22/kWh.

The study was presented to MEGTW, but not accepted as using projection data. MEGTW instructed to apply the actual data from demo project which is of course not available yet. Continuing with that, a new paper on RE tariff intervention in promoting SREP projects (Special Package) was prepared and submitted to Ministry of Energy, Water and Communications (MEWC) in 2005 to request government intervention for RE tariff uplift by RM 0.05 /kWh from AAIBE in promoting SREP projects. This is due to the prevailing 'unattractive' feed in tariff offered to SREP developers (RM 0.17/kWh). The paper was presented in Jawatankuasa Akaun Amanah Industri Bekalan Elektrik (JAAIBE, also see MESITA) in March 2005 but was rejected by the committee members. However, tariff increment to 0.19/kwh for biomass and biogas projects was announced during National RE forum in September 2006 in parallel with the FSM Demonstration Project Signing Ceremony. Following the events that came, a new power tariff of RM 0.21 /kWh for biomass and biogas projects was announced by the Minister of MEGTW on 7 August 2007 during the press conference on TNB tariff review. As a result, ST received more applications in SREP project when the proponents were informed that the default tariff has been uplifted to RM 0.21/kWh.

### 3.3. Project History, Implementation Timeline and Effects in Achieving Outputs and Outcomes

The GEF approved the BioGen Project on March 15, 2002 and its Project Document (ProDoc) was signed by UNDP and GoM on July 26, 2002. The project was approved for Phase 1 to be implemented in two years. Project activities started in January 2003 when the CTA (acting also as Project Manager) was hired. Initial funding was first disbursed in March 2003. Hence, the project was expected to be completed in December 2004. Considering the delays in implementation, a year extension was recommended and granted by the NSC placing the expected completion of Phase 1 to December 31, 2005. This decision was made realizing the need to change the approach in project operations and management and realign the activities to fast track the project (which was noted during the Mid-Term Review conducted in September 2004). Meantime, the private sector interest in the utilization of oil palm biomass for energy on a commercial basis has not developed yet because of the prevailing relatively low feed-in power tariff.

The Mid-Term Review (MTR) noted that the two-year Phase 1 was more of a capacity building phase which included in it the demonstration site supposed to be in the MPOB-Guthrie experimental mill as the first Full Scale Model (FSM). This was an existing experimental government POM for a 2 MW power generation capacity which was negotiated with MPOB during the project development and was expected not to have any problem in proceeding to demonstrate the biomass energy technologies for the palm oil industry and the private sector in general to appreciate. Project performance, outputs

and outcomes were largely affected by management-related issues which needed to be resolved first in order that the BioGen Project can fast track its implementation in addressing the program barriers that it was intended to achieve as stated in the ProDoc. There were areas that needed improvement in the inter-agency coordination and policy harmonization on the ministry level. The NSC tended to operate only on the project level as the venue for resolving project issues. The project was designed towards placing the BioGen as a strategic policy and technical support to the country's renewable energy strategy and program. The role and interest of MPOB and the possible coordination route were there in terms of coordination work in the palm oil industry sub-sector. The CTA's technical advice, directions and inputs did not come in as expected by the BioGen Team. Among the recommendations of the MTR was strengthening the role of the CTA as the key in effective project management and coordination of expected outputs from among participating agencies. In retrospect, the FE observed that this was not effectively met by the project at the project level as seen in the frequent turnover of the CTAs and in some periods when the project did not have a CTA. At the program level, the FE still sees the need for a central agency with specific mandate and organizational support to carry out a multi-sectoral BioGen program, particularly on the demonstration of the biomass/biogas technology and policy development and implementation.

The Interim Evaluation completed in February 2006 reported that, in spite of the preparations and capacity building efforts of the project, the first FSM was not installed as an important part of Phase 1. This should have paved the way to various other major supportive outputs of BioGen which were also delayed, including a workable REPPA to introduce an RE market for the power generated, a viable financing model and RE business facility, completion of financial and technical viability confirmation of biomass technologies and dependable biomass energy technology support. All these are needed to build up the confidence of the private industry and the financial sectors. This should have been the critical stepping stone for the succeeding three FSMs in Phase 2 where private sector would have joined in further demonstrating the biomass technologies aided by project support and financial assistance. Among others that the Interim Evaluation recommended, and for which the FE noted the project was able to act accordingly are on project extension, follow-through and full assistance to government in tariff setting, alternative financing mechanisms and project manpower complement. However, the FE observed that the following IE recommendations were not fully complied with: simplifying and fast tracking FSM hosting arrangements, strengthening the CTA's role, strengthening the network and organizational linkages among stakeholders, establishment of an M&E system, establishment of information exchange system and updating of the project plan and logical framework. The FE Team believes that these unfulfilled proposals remain very necessary and should have been effectively acted upon to significantly contribute to project milestones.

The many challenges confronted by the BioGen Project were not actually unexpected because they were identified during the project design as risks (or conversely stated as the assumptions and factors needed for project's success but beyond the direct control of the project). On the overall, the Interim Evaluation found the project to have met expected agreed standards of operational management and administration but with inability to achieve the main milestone of actual FSM installation and related activities because of factors external to the project. It was claimed to have been affected by the clamor for higher tariff rate by the targeted industry proponents who are still not convinced of the feasibility of biomass power generation. Most of the project stakeholders view this as something that is not immediately within the control of the BioGen Project. Meanwhile, the policy enhancement efforts in justifying an increase of tariff (which was then at RM 0.16 to 0.17/kWh) and other programmed activities continued to be supported by the BioGen.

In 2006, Kluang Oil Processing Sdn Bhd (KOP) proposed to install a 3-5 MW biomass/biogas CHP plant to be the qualified BioGen FSM installation for Phase 1. The Host Company could still pursue the project proposal for the 14 MW power plant under more favorable conditions to the full blown capacity if necessary. For some reasons including its demand to have a higher tariff, the KOP possibility also did not push through. The BioGen Project was again not able to install the first FSM and continued to explore other POMs that will act as host for the demonstration projects.

A satisfactory compliance of the BioGen Phase 1 outputs was the precondition to effect the transition of implementation to Phase 2 after approval by UNDP and GEF. By mid-2007, it was decided by UNDP and NSC not to proceed with Phase 2 since the expected outcomes in Phase 1 have not yet materialized in spite of the extension. Hence, even with the second extension of completion date to December 31, 2007, the project was not able to proceed to Phase 2 due to continued barriers faced by the project.

BioGen continued to be implemented by focusing on remaining outputs which are primarily on the selection of the FSM host companies. The uplifting of the tariff to RM 0.21/kWh as desired by the industry was granted in 2007. In 2008, MHES committed to install a 13 MW independent biomass power generation using EFB. Following it was the FPISB or FELDA POM which committed to install a 500 KW biogas power generation using POME.

In second half of 2009 and first half of 2010, BioGen activities consisted mainly of providing assistance to the engineering, installation and monitoring of the commissioning of the two FSMs. The table below shows the project timeline. The project is now in the mid of its seventh year since the project inception meeting in February 2003. Based on the original ProDoc timetable, the project had effectively three extensions of the closing dates: 31 December 2004, 31 December 2007 and 30 June 2010.

| Year 0 | Year 1 | Year 2 | MTR Target | Year 3 | Year 4 | Year 5 | EOP Target | Year 6 | Year 7 |
|---|---|---|---|---|---|---|---|---|---|
| 1 Jan 02 | 1 Mar 03 – 31 May 04 | 1 Jun 04 – 31 May 05 | 1 June 04 – 31 May 05 | 1 Jun 05 – 31 May 06 | 1 Jun 06 – 31 May 07 | 1 Jun 07 – 31 May 08 | 1 Jan 03- 31 May 08 | 1 Jun 08 – 31 May 09 | 1 Jun 09 – 31 May 10 |
| **Baseline** | **Extended Implementation Period - Phase 1** | | **Phase 1 Completed** | **2nd Extension Period** | | | **Phase 1 Completed** | **3rd Extension Period** | |

This FE which was conducted October – November 2010 served as the evaluation of the project since inception up to the final completion date of 30 June 2010 to include other tasks being done on the FSMs up to the time of evaluation. **Annex F** gives a more detailed account of the chronology of events regarding the FSM site selection.

## 4. ASSESSMENT OF PROJECT RESULTS

### 4.1. Progress Towards Achievement of Outputs

Among the key achievements that are expected from Phase I of the Project in order to transition to Phase 2 are: the finalization of the REPPA pro forma, the establishment of the RE Business Facility, the organization of the BOSC, the demonstration of the first FSM, the energy audits of selected POMs for selection of the next FSMs, different policy studies, biomass availability assessment, selection of host companies for the three FSMs, different workshops, promotional activities, and institutionalization of the biomass energy program and organization.

### *4.1.1. BioGen End-of-Project Achievement of Outputs versus Targets*

In summary, based on the assessment presented in **Annex G**, most of the outputs were already completed by Year 4 (July 1, 2006 to June 30, 2007). The highlights of achievement of outputs vis-à-vis the ProDoc commitments are listed below. Please note that the time element of performance, or indicative dates, were not included in the statements of targets and accomplishments in this section. This is considered in the rating of the accomplishment on the element of Efficiency as tackled in the said **Annex** discussed also in the next section.

## Component 1 - Biomass Information Services and Awareness Enhancement Program

This component was designed to bring about a sustainable and continuously evolving program of providing biomass energy technology information services, continuing education, and awareness enhancement, covering the energy applications of biomass and biomass-derived waste materials, particularly biogas is established and implemented by the project.

In general all outputs were delivered, except the accreditation system and designation of an agency for RE consultants (Output 1.6) and the establishment of a rating scheme for biomass-based companies (Output 1.7). Rating scheme was not implemented due to the sensitivity of data presented in the scheme which will reveal the business performance of each POM. An alternative study on baseline of biomass residue and energy utilization to 100 POMs was rather implemented. Detailed outputs are described below.

1.1: *Comprehensive Biomass Energy Resource Inventory*

A biomass resource survey of palm oil waste, wood waste, rice husk, bagasse and municipal solid wastes (MSW) was expected to be done. This was completed by SIRIM as planned resulting to the national biomass resources inventory and identification of its energy potential. The second survey on palm oil mill biomass baseline (refer to output 1.7 below) was carried out by BioGen as substitution to the development of rating scheme (refer to 1.7). BRIS was developed and data were continually updated partially up to 2008. However, the FE Team noted that the data gathered from the baseline survey by BioGen was not updated; the data elements in BRIS were not expanded. The potential power generation from the oil palm residues (EFBs, fibers, shell and POME) is about 2,418 MW, paddy residues (155 MW) and wood wastes (56 MW). The result was used as an input to set the target for 9$^{th}$ Malaysia Plan.

1.2: *Biomass Energy Technologies and Technology Applications Database*

This was expected to involve the design and development of a database of biomass energy technologies and technology applications in Malaysia and the corresponding data and information exchange system to be completed June 2005. Biomass technology information compiled and uploaded to BioGen Web Portal. Biomass technology database prepared and uploaded. Utilization of database monitored at website. Updating is organized based on ad-hoc /request basis without regular schedule.

*1.3: Training Courses on Biomass Energy Technology*

The conduct of training courses and provision of necessary technical materials on biomass energy technology for PTM staff, POM personnel, university students, and local engineering consultants were expected to be completed. Two in-house training courses were conducted with 19 PTM (now MGTC) staff trained. The consultant has prepared 1) Lecture Manual for Degree Course and 2) Course Materials for MPOB Diploma (Biomass Technologies for Renewable Energy and Biogas Production Technologies from Biomass). The syllabus was incorporated in Faculty of Engineering of Universiti Tenaga Nasional (UNITEN) and UKM and continued as part of engineering syllabus requirement. While for MPOB, a syllabus on biomass-based power generation and CHP was included in addition to the Engineering Diploma Course provided by MPOB to the palm oil industry. More than 100 schools adopted the course topic of Energy Efficiency and Renewable Energy for Secondary School Curriculum in collaboration with Centre for Education, Training and Research in Renewable Energy and Energy Efficiency (CETREE)/USM.

*1.4: Integrated Information Dissemination Program*

This should involve PTM/MECM and the relevant private and government agencies working on biomass energy development in terms of RE information services, creation of a special unit for biomass technology in MGTC, incorporation of RE information in MTGC website and preparation of project profiles. At least 10 customers were serviced by the One-Stop-Center (OSC). The web and database which was incorporated in MGTC's homepage is widely used by universities, researcher, private sector and consultancy firm and has become one of the reference points for biomass / biogas information in the country. The data on POMs was further updated in 2007 with strong support from MPOB and MEGTW.

*1.5: Biomass Energy Technology Information Exchange Services*

Information exchange services should include review activities of local biomass energy research institutions, monitor of ongoing technology applications, consolidation of information and setting up of an information networking services. The information exchange service is functioning. Publication of BioGen Newsletter and incorporation BioGen news in the issues of Energy Smart Magazine were done and the information materials were disseminated. However, the newsletter is not being published on regular basis currently. 10 renewable projects were monitored and 9 of them published on BioGen Portal. Project profiles for monitored projects were prepared but not regularly updated.

1.6: *RE Consultancy Service Industry (ESI) Development*

This program should include capacity building to local energy consulting firms, technical support to ESIs, and training of local engineering firms. At least 10 local consultants were trained. However, no monitoring of their engagement after training is being done to measure effectiveness. No accreditation body is available or established to implement the requirement for RE consultants.

*1.7: Rating Scheme for Biomass-based Companies*

This was intended as a promotional activity to involve the design of an environmental rating scheme based on the magnitude of realizing the potentials for using biomass energy by end of 2005. Due to some difficulty faced by the team to appoint the qualified consultant, this activity was done in-house with strong support from MPOB. To avoid any issue with the proposed rating scheme, this activity was changed to

determination of baseline conditions using a set of criteria for technical, financial and social impact with basic calculation on the magnitude of realizing the potentials for using the company's biomass resources. The performance of the POM in managing the byproduct/wastes is evaluated based on waste utilization, total excess biomass waste, GHG emission reduction, etc. The baseline survey tool was used in selected 100 POMs and reported that, among other findings, more than 90% of the POM wastes (EFB and palm kernel shell (PKS)) are being utilized mainly for internal consumption, incinerator, sold, mulching and composting. The detailed results from the study were used as input for the development of RE policy and action plan.

## Component 2: Biomass Policy Study and Institutional Capacity Building

Component 2 was expected to influence the adoption by the GoM of a clear government policy and accompanying implementing rules and regulations on the utilization of biomass energy for power generation. In verifying if this outcome is achieved, there should be documentation of GoM policy on biomass power generation/cogeneration and a monitoring system to track prospective biomass power generators complying with rules and regulations on biomass power generation.

Generally, the outputs from this component (except Outputs 2.5 and 2.7) were delivered satisfactorily. The institutional framework (Output 2.5) was not formulated clearly for BioGen implementation. The only institutional framework in place was the SREP. Monitoring of the adopted policy (Output 2.7) was not implemented as the RE Policy and Action Plan was only approved in April 2010. However, the FE Team noted that a proposed M&E system can be anticipated even during the drafting and approval process according to what outcomes the policy aims to achieve and thereby clarifying expectations of the policy and how to monitor its effectiveness. This should have been be a good tool for the proponents and the policy making body to understand the intents of the policy. On the other hand, however, alternative financing via Clean Development Mechanism (CDM) was executed well under the auspices of MNRE and MGTC (previously PTM) and the success can be observed from the CDM statistics provided. The FE Team observed therefore that while the institutional framework and M&E system were not achieved by BioGen, there are isolated M&E systems that could be integrated which can be administered under a responsible agency at the national level. Other development alternatives that were identified were also not realized. Details of the achievement of outputs for the Component 2 are described below.

*2.1: Biomass policy document and analysis*

A policy study on how the biomass resources of the country will be put to good use was expected. Workshops to discuss RE policy and action plan were also conducted. A draft policy paper was prepared. A policy document on "Proposed Mechanisms to Expedite the Implementation of RE Projects" was prepared and submitted to MEWC. It proposed changes in the strategy and implementation mechanism of RE project development to ensure the achievement of the revised RE target of 350 MW grid connected by the end of the 9$^{th}$ Malaysia Plan (2006 - 2010) i.e. tariff escalation based on oil market price, soft loan, environmental regulation, incentives, etc.. Policy recommendations were reviewed and approved by NSC and incorporated in the 9$^{th}$ Malaysian Plan. Based on the above document, an RE roadmap was prepared to tackle issues which were identified as barriers in RE project development.

*2.2: Biomass energy utilization workshop series*

This should have involved the organization of several one-day workshops in various locations in the country in collaboration with the CETREE project sponsored by Danish Cooperation for Environment and Development (DANCED) for the POM personnel while disseminating the biomass policy and its program. This resulted to the conduct of the planned workshops.

*2.3: Renewable Energy Electricity Generation Policy*

Expected under this activity is the development and recommendation of policies and regulations on RE-based electricity generation. These would include the development of, and providing assistance in negotiating, standard long-term biomass fuel supply agreements and standard steam/heat off-take and electricity purchase agreements. Simplified terms and conditions for VSREP were prepared and adopted by TNB for small RE projects. VSREP REPPA was reported to be applied to other recent RE projects.

*2.4: Renewable Energy Electricity Pricing*

This activity is expected to provide assistance in addressing the issue concerning the pricing of, and off-take requirements for, RE electricity from the biomass based power generation and CHP.A study was also conducted by BioGen together with fellow from Columbia University on the "Overview of the International Renewable Energy Policies and comparison with Malaysian Domestic Policy". The policy recommendation was also incorporated in the 9$^{th}$ Malaysia Plan based on the BioGen endorsement. Further, the initial RE policy was refined by BioGen and an RE Action Plan was also prepared including the implementation of the feed-in-tariff (FIT) in Malaysia.

*2.5: Develop Institutional Framework to Implement Biomass-based Power Project (replaced the Power Generation Market Strategy during the Logical Framework Analysis (LFA) updating in June 2004)*

This activity should include evaluating possible incentives for prospective investors, and appropriate terms and conditions for grid connection. This was not implemented by BioGen. The institutional framework was already set up under the SREP application framework (where BioGen is also involved).

2.6 *Policy Formulation for Alternative Financing for RE Power Generation Projects (replaced the Malaysia Power Market Simulation Model during the LFA updating in June 2004)*

BioGen through its power market consultants was expected to develop a power market simulation model that considers the biomass-based power generators as among the major players in a Malaysian open electricity market. Three (3) awareness programs on CDM were undertaken by presentations to key stakeholders. Alternative financing options were also identified, viz. Equity funding, Venture Capital, Expansion of Renewable Energy Business Facility (REBF), Cooperative, CDM. The provision of a renewable energy fund was suggested in the ProDoc as a barrier removal intervention for the lack of financial resources to support biomass/biogas projects. As implemented, the scheme became the establishment of a renewable energy business facility (REBF) which was considered to be the most viable for the purpose of showcasing RE projects in general through the FSMs. However, the availment of the REBF was not realized because the prospective hosts had to view the FSMs as commercial projects considering the fact that the fund is loaned out using standard

terms and conditions. Accordingly, the financial viability was not evident because of the need to have higher power tariff at that time. When the tariff was uplifted in 2007, the number of biomass/biogas projects undertaken together with the CDM incentives was seen increasing over the 2004-2009 period (**Annex G**) based on the data of the Energy Commission. The FE Team believes that the REBF should be continued and further expanded with the help of the financial sector under the present circumstances of higher tariff and the need for support in project development of biomass/biogas projects considering the BioGen experience to ensure quality feasibility and market studies towards more successful ventures.

*2.7 RE Policy Implementation Monitoring and Evaluation (replaced RE Electricity Policy Implementation Program Evaluation during the LFA updating in June 2004)*

The project is expected to monitor and evaluate the response from the palm oil industry to the government's efforts in promoting biomass-based power generation. According to the BioGen Project Team, this activity was not carried out as the RE Policy and Action Plan was yet to be endorsed. The FE Team noted that an M&E plan even while the policy is still being formulated and getting approval, it is necessary that the performance indicators and measures should have been identified already and hence, the implementation requirements can easily be articulated and commitment can be sought with determination and clarity. As seen in the PIR reports, the BioGen project Team decided to have the M&E system done in Phase 2 and therefore the design of the M&E system was not realized at the current project phase. The FE Team believes that an M&E system design is very important and should have been done at the outset because of the necessity of defining performance standards and a means of tracking results. The FE team recommends that the MEGTW should be able to pursue this along the proposal to have a central implementing agency for the RE program.

## Component 3: Biomass Initiatives Financing Assistance Program

The objective of Component 3 is to encourage the government, private sector and the financial community to provide financial assistance to the development and implementation of biomass-based power generation and cogeneration projects. The success is based on financing assistance programs for biomass energy technology applications that are established and availed of by prospective project developers, and the financing and banking sectors are providing financing for biomass-based power generation and cogeneration projects.

It is important that the financial institutions that have participated in the financial training program and have agreed to finance biomass power generation projects are identified and made active in the program. Similarly, the potential biomass power generators applying for project financing and those that were already granted or are still applying or waiting for approval of financial assistance under REBF are also identified and assisted in the process. Several activities have been included to achieve this plan. The related DANCED biomass assistance program of the GoM is a study where BioGen's financial approach could be complementary in terms of strengthening the technical capability of the financing institutions on RE power projects and could encourage financing schemes to support RE projects.

Highlights of the Component 3 achievements include the setting up of the REBF successfully. However, it was not successfully utilized or further developed. BioGen's assistance to the 1$^{st}$ FSM (MHES) on financing of the project was extensive and

successful which resulted in the issuance of BPMB bank offer. The technical challenges faced by the FSMs (especially the MHES project) and the length of time needed in tackling the tariff issues presented by proponents at the time of FSM selection (2003 – 2004), albeit beyond immediate scope of the BioGen project, have led to the delay in the demonstration of a successful financing model needed to showcase the desired favorable business angle for other projects. Thus, this situation affected other related outputs.

*3.1 Training courses for local banking and financial institutions on financing RE projects in industries*

The planned two training courses for private and government financial institutions have been conducted in October 2003and July 2004.

*3.2: Establishment of a RE Fund (Energy Business Fund) that will support RE initiatives of prospective biomass energy users*

Expected output under this activity is the establishment of the Energy Business Fund by end of 2004. REBF was established in the amount of RM 28 million set up with BPMB or the Development Bank of Malaysia) in July 2005. It consists of RM 9 million from GEF and RM 5 million from the GoM. The total of RM 14 million was matched by the RM 14 million coming from BPMB to make the total of RM 28 million for use by the REBF for biomass-based power generation projects of BioGen. The 1st FSM was granted RM 5 million REBF loan to finance its EFB gasification for power generation at a capacity of 13 MW with the balance of its requirements coming from their own stakeholders. The financial status of the REBF fund as of October 2010 is in the amount of RM 23 million. The FE Team noted that while the GEF funds appears as almost fully spent, there is still about RM 9 million remaining unspent actually mainly due to the fact that FPI decided to utilize internal funding instead of applying under the REBF.

*3.3 & 3.4: Mechanism and Criteria for the financing scheme*

The development of the financing scheme was expected to be done in coordination with the MoF, EPU, Ministry of International Trade and Industry (MITI) and MECM to also define compatible schemes and their roles in the REBF scheme. The output expected was the documentation of the scheme that will entail clear mechanics of the REBF, including the criteria for financing eligibility. The two activities were combined in one study which was done by a single consultant. The study on the Financing Schemes was completed by HR System & Consultant Sdn. Bhd. documenting the financial scheme terms and conditions. This scheme was finalized and tested for the FSM (including CDM applications) through Letters of Offer incorporating the terms and conditions itself. The expected outputs for the two activities as combined were met satisfactorily.

*3.5:* Arrangements *for financial assistance for eligible RE projects*

This output refers to the arrangements that will be made for the companies who are eligible for availing of the financing assistance from the REBF. About 50 of palm oil millers were expected to avail of the RE Business Facility financing. A survey of 100 POMs was conducted on their interest and knowledge of all available financing for Biomass/Biogas projects. Seven (7) were interested on the availment of the FSM financial assistance program.

*3.6 Evaluation of RE Project Financing Assistance Program*

The output in this activity was expected to provide the necessary information as to how the financing assistance program of the project performed if all the financed projects were meeting the repayment schedule after 2 years of project implementation. The Team noted that the REBF was not expanded and made available to other POMs for the reason that the facility may not be enough anymore for the requirements of the FSMs. On loan performance, the 1st FSM (MHES) was not achieving the designed capacity at point of evaluation. Hence, the requested loan was not released to MHES due to lack of confidence by the bank on MHES's capacity to repay the loan from the expected revenue of the power plant. On the other hand, the 2nd FSM did not avail of the REBF loan. The project owners decided to finance the biogas power generation plant using their own funds. The FE Team observed that, as designed, the use of the REBF pre-supposed that the POMs will avail of the loans after the FSMs have resulted in successful demonstration of the technical and financial viability of the RE-based power generation schemes as defined under the original arrangements presented in the ProDoc using existing experimental mills by MPOB.

It is noted that the REBF establishment was successful and is a major accomplishment of BioGen in demonstrating the preparedness by the banks to consider RE projects in their portfolio. Further, it was noted that BPMB has delivered additional funds amounting to RM 100 million for the purpose of biomass investment including the biofuel development plants. However, since the original FSM plan did not materialize the use of the REBF met some difficulties. The succeeding prospective hosts demanded a higher tariff which affected the FSM implementation because they have to use standard loan terms while still proving the technical and financial viability for technology showcasing purposes. The REBF therefore was applied inappropriately in projects that are still of the original Phase 1 (barrier removal type) projects. In the case of the first FSM, the MASB is having difficulty paying for its REBF loan because it has still to resolve basic technical and operational problems in the EFB feeding system yet when it discontinued its power generation several weeks after start-up. On the other hand, the second FSM (FPI), showed that although important, financial instruments were not necessary a crucial barrier for all developers to implement RE projects. Some developers (like FPI for instance) did not need any financial assistance and are able to self-fund the projects.

The REBF platform can still be used after the project closing to support biomass/biogas (or RE in general) projects together with a project preparation and/or development support window and the other incentives that GoM will have to employ in order to tap the big potential of REs in the national energy mix. Therefore, the REBF needs to be reviewed and adopted to the present situation and expanded considering the BioGen experience in order to meet increasing interest as shown in increasing number of RE projects due to the increased tariff.

## Component 4 – Biomass based Power Generation and CHP Demonstration Program

Component 4 is to facilitate the effective demonstration of the techno-economic viability, design, development, financing and sustainable operation and maintenance of biomass-based grid connected power generation/CHP projects. This will entail the techno-economic feasibility of biomass-based power generation/CHP in suitable POMs, including the necessary implementation requirements from the GoM, TNB

and biomass waste suppliers established. The implementation arrangements should have been finalized with TNB, biomass suppliers, finance institutions and the GoM.

Secondly, it is to demonstrate the techno-economic viability, design, development, financing and sustainable operation & maintenance of biomass-based grid connected power generation/CHP. According to plans, the MPOB-Guthrie experimental mill will have been retrofitted to become operational as an efficient and viable grid-connected biomass power generation plant using palm oil solid waste and POME-derived biogas by end Year 2 and would have been available for view by interested parties.

On the accomplishment highlights, despite the lengthy delays in securing the hosts for the demonstration scheme, the installation of the 2 FSMs were finally realized and executed. MoAs and REPPAs were successfully concluded. Fuel supply agreement was executed for the 1st FSM (MHES) which has the power plant located away from POMs or plantation. The 2nd FSM (FELDA), being a POME-biogas power plant, is attached to FELDA's POM. However, both FSMs were not found to be fully completed and operational according to the desired design during the FE. The MHES was not yet fully operational because of the modification of the fuel feeding system after failure of the original fuel feeding system to function as desired. The FELDA POME-biogas plant is already supplying 500 kW power for on-site usage of the FELDA POM while the implementation of the plans to upscale the capacity to 1 MW and to interconnect the facility to the grid are already on stream during the evaluation. Details of the two FSMs can be seen in **Annex H**. The FE Team noted however that a systematic monitoring and evaluation system by BioGen for the operation and power delivery of the 2 FSMs was not demonstrated except for the field reports mentioned being done by the BioGen Technical Team.

### *4.1 Biomass-based Power Generation and CHP Demonstration Program*

Under this activity, a seminar-workshop will have been conducted and attended by major stakeholders including beneficiaries completed and about 20% of the palm oil millers who attended the workshop applied for hosting the demonstration schemes. As a result, the seminar (an RE Forum) was carried out as attended by 16 POM stakeholders. The same number of applications was received from participating POM companies.

### *4.2 Selection Criteria for Host Demonstration Companies*

The selection criteria were expected to be well documented and approved by the relevant body to be identified during the implementation of this activity and used by MGTC. All potential demonstration sites will have been evaluated and four companies selected for demonstration schemes. Further, pre-feasibility studies should have been carried out at 4 selected sites, comprehensive feasibility evaluations for the 1st FSM completed and the MoA for the 1st FSM will have been completed and signed by all parties, as well as for the other 3 FSMs. Resulting from the activities, the criteria for host demonstration companies were prepared and the FSM selection process chart was prepared as planned. Seven (7) potential companies applied and the applications were reviewed. Subsequently, 4 applicants were selected and feasibility studies conducted. But due to varying reasons, all 4 projects did not proceed to participate as the FSMs. The project dragged on until MHES and FELDA Serting Hilir applied to be host of the FSMs and both were consequently selected. The evaluations for 1st FSM (MHES) and for the 2nd FSM (FELDA) were completed in October 2006 with reports on Technical and Economic

Pre-feasibility Study. The MoA of 1st FSM was signed in November 2006 and the 2nd FSM was signed in April 2007. The FE Team noted that there were only 2 FSMs instead of the 4 targeted.

*4.3 Specific Demo Scheme Implementation Barrier Removal Activities (replaced the Suitable Project Demonstration Sites during the LFA updating in June 2004)*

Under this activity, the following were expected: Verified and confirmed availability of biomass volumes and POME biogas to support demo schemes for the 4 FSMs; long term biomass supply agreements for the 1st FSM is approved/signed and for the other 3 FSMs; the standard agreement is adopted by at least 2 additional biomass based power projects; REPPA is prepared and approved by relevant parties (i.e. TNB, host company); financing assistance mechanism for the demo schemes investment is set-up and implemented; and favorable purchase price from 1st FSM is confirmed and REPPAs between TNB and host companies are secured.

Resulting from the activities, the REPPA for 1st FSM was signed (for 21 years). An addendum to the REPPA for uplifted tariff and removal of performance target was done. The REPPA for 2nd FSM was signed (for 10 years). The FE Team noted that was only made possible when the REBF was set up and implemented and a favorable purchase price was achieved with uplifted tariff of RM 0.21/kWh was agreed in both FSMs. This remained to be the most significant barrier until their final removal in later years.

*4.4. Baseline Data Establishment for Demonstration Sites*

Under this activity, the following were expected: energy audits conducted at four demo host and baseline performance data established and also the remaining 3 FSM; operating performance targets for the planned biomass-based power generation/CHP facilities are defined for the 1st FSM and for the other 3 FSMs; baseline data and performance evaluation data are incorporated in the "Biomass Energy Technology Database" and shared to other biomass power generation project developers; 1st FSM basic design and also for all other FSMs (new and retrofit) completed; comprehensive technical and economic feasibility evaluations completed for all other FSMs; detailed engineering designs for the 1st FSM completed and approved and also for the other 3 FSMs; and at least 3 sites replicated project demonstration based on the 1st FSM basic design.

Resulting from the activities, engineering designs for 1st FSM and 2nd FSM were completed, evaluation of the FSM proposals was carried out; and detailed engineering design for the 2 FSMs were completed. However, no replication of the demonstration sites based on the same technology documented for the 1st FSM was realized since the project is already nearing completion. For the 2nd FSM, however, FELDA has adopted similar biogas design for other sites (e.g. Maokil, Kemahang POMs) also.

*4.5. Installation and implementation designs/plans of first demonstration site*

Expected outputs in this activity which were completed as planned are the Engineering, Procurement and Construction (EPC) contracts for the equipment procurement and delivery.

*4.6. Financial Assistance Arrangements for Demonstration Sites*

Under this activity, the FSM arrangements included and completed the "must have" requirements of availability of biomass volumes to support demo schemes, standard long-term biomass supply agreements, standard heat/steam off-take and electricity purchase agreements, agreement with TNB and host companies regarding a favorable purchase price of RE electricity. The financial assistance package for the demonstration sites was established to assist in meeting the cost requirements of demonstrating the BioGen technologies. Hence, the intent of this activity was satisfied as the FSM hosts, e.g. MHES & Felda were both given the opportunity to utilize the fund. MHES availed of a portion of the loan at the beginning but since the plant stopped operation, the remaining portion of the loan was not awarded to MHES because the ability of the company to support the full loan became the issue until the plant is operated successfully. On the other hand, Felda declined to use the package and used its own resources.

*4.7. Hardware Installation and Operation for each Demonstration Scheme*

This activity includes civil engineering and support facilities construction completed for 1st FSM and for the other FSMs and the installation and commissioning for both FSMs. After the civil engineering and support facilities construction were completed for both FSMs, testing and commissioning of the 1st FSM was achieved on 9 November 2009 while or the 2nd FSM, they were achieved in the 1st quarter 2010 for on-site consumption. Electricity export to grid by the 2nd FSM is scheduled in the 3rd quarter 2011. The Technical Assistance (TA) that was supposed to be provided for the 1st FSM in overseeing the commissioning of the facilities was not engaged since the MHES engaged its own owner's engineer. For the required evaluation, the BioGen Team conducted regular site visits while BPMB conducted their own assessment in connection with the loan agreements. A more detailed profile and description of the two FSMs is seen in **Annex H**.

*4.8. Monitoring and Evaluation of each Demonstration Scheme*

Evaluation was done for 1st FSM in October 2006 highlighting the operating and economic performance. Other SREP projects benefited from the REPPA conditions experience from the FSMs. Additionally, improvement of tax incentives were adopted by the government for similar projects. These include incentives given for being at a pioneer status, e.g., investment allowance, carbon credits, tax exemption, etc. The experience gained in the FSMs was presented at the 2nd Annual Sustainable Energy Conference on 10-11 November 2008 and also in other conferences and workshops.

The FE Team noted that there is no existing M&E system in BioGen to monitor the impacts of the project as required by the BioGen ProDoc. Statistics gathered by the FE Team from the EC showed that the number of biomass/biogas projects was increasing since 2007**,** in spite of the not yet successful operation of the BioGen demonstration plants. The installed capacity of biomass-based power and CHP systems in the country has increased to 48 MW as of March 2010, though still fall short of the 100MW targeted by the BioGen for 2008. The number of SREP applications increased from 14 in 2006 to 34 in 2010.

**Annex I** shows a summary of information on CDM projects including **Table G-1** on Registered Biomass/Biogas CDM projects in Malaysia (up to Oct 2010), **Table G-2** on Green Technology Financial System (GTFS) List – Certified, **Table G-3** on Installed Capacity and Number of Applications in Biomass-Related Projects, **Table G-4** on Statistics of SREP Projects by Fuel Source; **Fig. G-1** on the Number of Small

Renewable Energy Projects over last five years in Malaysia; and **Fig. G-2** on Number of CDM Applications related to BioGen in Malaysia. The GoM has established the Green Technology Financial System (GTFS) as a follow-up program to support green energy, which includes RE projects. At least 10 biomass/biogas related project applications were already received. Another follow up BioGen activity is to lodge proposals for sustainable biomass-based power generation; however, it was not carried out and was relegated to be done in the next phase of the project.

### Component 5 - Biomass Energy Technology Development Program

Component 5 is expected to address the identified technical barriers that hinder the promotion and implementation of biomass-based projects for energy purposes. The activities that will have been carried out are mainly geared towards establishing the needs and potentials of biomass resource applications, including the provisions for assisting proponents and developers of biomass-based power generation/CHP system projects. This will have entailed assessment of other commercial application of the surplus biomass resources, existing local manufacturers of equipment related to biomass power generation, existing design practices in power generation and potentials for increased capability and support from the local industry, and the technical and financial support needed to further enhance private sector participation.

On the highlights of accomplishments, only Outputs 5.1 to 5.3 were executed under BioGen. However, Outputs 5.4 to 5.7 were not done by BioGen as approved by NSC because they were already accomplished equivalently by another UNDP project, the MIEEEP. Training activities involving C1 were executed in collaboration with Component 1. Activity 5.8 was not executed as this was planned to be part of Phase 2 implementation.

*5.1. Assessment of the other energy and non-energy related uses of biomass in the palm oil industry*

A comprehensive report for potential energy and non-energy related uses of palm oil biomass completed though there was no re-evaluation conducted by BioGen as required in the ProDoc.

*5.2. Evaluation of the energy utilization performance in POMs*

BioGen was expected to conduct 8 energy audits on selected palm oil mills for which the same number of audits was accomplished which highlighted the detailed findings and improvement recommendations as required.

*5.3: Training for Palm Oil Mill Power Plant Engineers and Operators*

This output was intended to equip the POM personnel the necessary knowledge and skills on the safe, efficient and environmentally friendly operation of biomass-based power generation and/or CHP systems. It was also targeted for the certification of POM engineers to operate high pressure and high voltage steam power and CHP systems.

A training session was completed (in-collaboration with C1) while the 2$^{nd}$ training was conducted by MPOB as part of the existing MPOB and Institute Latihan Sultan Ahmad Shah (ILSAS) program on biomass-based power generation and CHP for POM personnel, The development of Hazard Operationability (HAZOP) model for retrofitting of existing POMs was completed and a HAZOP training material for

biomass-based power generation system was developed by UTM for the project.

The MIEEIP provided the necessary assistance under C5 and there was no significant funds allocated. Activities 7.1 - 7.4 of the MIEEIP covered the BioGen C5 activities. In this regard, the C5 activities were no longer implemented as they were deemed redundant. The NSC accepted and endorsed the changes which were then reported in the BioGen PIR reports. The activity on designing the power generation auxiliary equipment was not implemented separately but was part of the Full Scale Model demonstration project.

*5.4. Assessment of capabilities of local steam and power generation equipment manufacturers*

The assessment which was expected to highlight findings and improvement recommendations was not carried out by BioGen because the same activity was carried out already in another project of MGTC, the MIEEIP. The MIEEIP report "Local Energy Efficient Equipment Support Program" (July 2002) presents the results of such activity under the MIEEIP. The output/requirement of this activity was decided to be similar as with Component 7 of the MIEEEP. Hence, it was presented and endorsed by the NSC 1/2007 for Activity 5.4 so as not to repeat similar activities. The budget for this activity was re-allocated to the FSM activity as described above as it would be meaningful for the FSM to be completed and serve as the demonstration to the local manufacturers.

*5.5 Performance Evaluation of Local Produced Steam and Power Generation Auxiliary Equipment*

Similarly, this evaluation which was expected to highlight findings and improvement recommendations was not carried out by BioGen because the same activity was carried out already in another project of MGTC, the MIEEIP. The MIEEIP report "Evaluation of Typical Energy Performance of Selected Locally Produced Industrial Equipment" (2004) presents the results of such activity under the MIEEIP. An update of the evaluation was supposed to be done in Phase 2 of BioGen. Considering that the output from the MIEEP activity is the same as the expected output from this activity, it was decided and endorsed by the NSC in May 2005to re-allocate the budget for this activity to the budget for the FSM activity,

*5.6. Training course for local steam and power generation equipment manufacturers on high efficiency designs and production technologies*

The conduct of a basic training course, in collaboration with UNITEN/ILSAS, on high efficiency design and production of steam and power generation technologies was expected to be done by BioGen. Instead, similar to Activities 5.4 and 5.5, the activity was carried out already by a related project of MGTC, the MIEEIP. Considering that the output from the MIEEP activity is the same as the expected output from this activity, it was decided and endorsed by the NSC 5/2005 to re-allocate the budget for this activity to the budget for the FSM activity

*5.7. Financial assistance to local steam and power generation equipment manufacturers*

The expected output here regarding the financial assistance to two (2) local steam and power generation auxiliary equipment and balance of plant manufacturers already qualified for the financial assistance provided under Component No. 8 of the MIEEIP, hence BioGen did not pursue this anymore. Considering that the output

from the MIEEP activity is the same as the expected output from this activity, it was decided and endorsed by the NSC 5/2005 to likewise re-allocate the budget for this activity to the budget for the FSM activity.

### *4.1.2 Summary of Output Ratings*

Overall, the project achieved most of the expected outputs. However, some of the key outputs, particularly the demonstration of the biomass-based power generation technologies in the FSMs suffered extensive delays in the site selection, preparation and implementation that took more than seven years, instead of the three years originally intended or the same set of outputs. The inability of the project to successfully demonstrate the technologies affected also the other relevant outputs linked to it and therefore experienced shortcomings in the achievement of the objectives in terms of *effectiveness* (outcomes commensurate with project objectives) and *efficiency* (cost and time taken to achieve outcomes).

**Table 1** presented below separately for the five components, summarizes the findings regarding the project outputs vis-à-vis project expectations in the ProDoc (and/or as modified and approved in the course of implementation by NSC) as presented also in detail in **Annex G.** The FE Team noted that some of the outputs were modified during an updating of the Logical Framework on June 30, 2004. On the other hand, some of the planned outputs in Component 5 were not done by the BioGen Project as approved by the NSC because they were already equivalently accomplished in another UNDP-GEF project, the MIEEIP also implemented by MGTC. Accordingly, they were marked as N.A.

On the overall, the BioGen Project is rated Marginally Satisfactory (**MS)** in achieving project outputs. The FE Team conducted necessary data gathering and interviews to verify specific achievements which are also included the said annex.

**Table 1: Summary of Output Accomplishment Ratings**

| Performance Indicator | Rating | | |
|---|---|---|---|
| | **Relevance** | **Effectiveness** | **Efficiency** |
| **Component 1: Biomass Information and Awareness Enhancement** | | | |
| 1.1: Comprehensive Biomass Energy Resource Inventory | S | S | S |
| 1.2: Biomass Energy Technologies Database | S | *S* | *MS* |
| 1.3: Biomass Energy Technologies Training Course | S | *MS* | *MS* |
| 1.4: Integrated Information Dissemination Program | *S* | MS | MS |
| 1.5: Biomass Energy Technology Information Exchange Service | S | *MS* | *MS* |
| 1.6: RE Consultancy Service Industry Development | MS | *MU* | *MU* |
| 1.7: Biomass Energy Rating Program | MS | *MS* | *MS* |
| **Rating per criterion for Component 1** | **S** | **MS** | **MS** |
| **Overall rating for Component 1** | **MS** | | |

| Performance Indicator | Rating | | |
|---|---|---|---|
| | Relevance | Effectiveness | Efficiency |
| **Component 2: Biomass Policy Study and Institutional Capacity Building Program** | | | |
| *2.1: Biomass Policy Analysis* | S | MS | MS |
| *2.2: Biomass Energy Utilization Workshop Series* | S | S | S |
| *2.3: RE Electricity Generation and Sales Study* | HS | S | MS |
| *2.4: RE Electricity Pricing Study* | HS | S | MS |
| *2.5: Develop Institutional Framework to Implement Biomass-based Power Project* | MS | MS | MS |
| *2.6: Policy Formulation for Alternative Financing for RE Power Generation Projects* | MU | MU | MU |
| *2.7:* RE Policy Implementation Monitoring and Evaluation | NA[1] | NA[1] | NA[1] |
| **Rating per criterion for Component 2** | **S** | **S** | **MS** |
| **Overall rating for Component 2** | **MS** | | |

[1]NA rating here means assessment is Not Applicable. While the M&E system for the project was defined by the project, the team has no basis to monitor and evaluate the impact of the policy implementation at this time. As reported in the PIR, Act.2.7 can be done in a follow-up project in the future. Related discussion can be seen in Section 4.1, Component 2 above.

| Performance Indicator | Rating | | |
|---|---|---|---|
| | Relevance | Effectiveness | Efficiency |
| **Outcome 3: Biomass Initiatives Financing Assistance Program** | | | |
| 3.1 Training course on RE project financing | S | S | S |
| 3.2 RE Business Facility Establishment | S | S | S |
| 3.3 Financing scheme mechanics and eligibility criteria | S | S | MS |
| 3.4 Criteria for selecting fund applicants[2]. | S | S | MS |
| 3.5 Financial Assistance Service to Applicants | S | MS | MS |
| 3.6 Evaluation of RE Project Financing Assistance Program | MS | MU | MU |
| **Rating per criterion for Component 3** | **S** | **MS** | **MS** |
| **Overall rating for Component 3** | **MS** | | |

[2]This was combined with Activity 3.3 under one contract.

| Performance Indicator | Rating |
|---|---|

| | Relevance | Effectiveness | Efficiency |
|---|---|---|---|
| **Component 4 – Biomass based Power Generation and CHP Demonstration Program** | | | |
| 4.1. Biomass-based Power Generation Demonstration Scheme Promotion | S | MS | MS |
| 4.2. Selection of Host Demonstration Companies. | S | MS | MS |
| 4.3. Specific Demo Scheme Implementation Barrier Removal Activities | MS | MS | MS |
| 4.4. Baseline Data Establishment for Demonstration Sites | *MS* | MS | MS |
| 4.5. Installation and Implementation Designs/Plans for the FSM Schemes | *S* | MS | MS |
| 4.6. Financial Assistance Arrangements for Demonstration Sites[3] | S | S | S |
| 4.7. Hardware Installation and Operation for each Demonstration Scheme | MS | MS | MS |
| 4.8. Monitoring and Evaluation of each Demonstration Scheme | *MS* | *MS* | *MS* |
| **Rating per criterion for Component 4** | **MS** | **MS** | **MS** |
| **Overall rating for Component 4** | **MS** | | |

[3]Financial assistance window was satisfactorily established as planned. While access was made available, however, full usage was not achieved. Candidate companies for FSM demonstration were given the opportunity to utilize the fund for technology demonstration. MHES was awarded an initial amount, but due to some technical issues, they stopped the plant operation, so they were not able to avail of the full loan amount. FELDA opted to use their own funds.

| Performance Indicator | Rating | | |
|---|---|---|---|
| | Relevance | Effectiveness | Efficiency |
| **Component 5: *Biomass Energy Technology Development Program*** | | | |
| 5.1 - Assessment of Other Energy-and Non-Energy Uses of Palm Oil Industry Biomass Waste | S | S | S |
| 5.2 - Evaluation of Energy Utilization Performance of Palm Oil Mills | S | S | S |
| 5.3 - Training for Palm Oil Mill Power Plant Engineers and Operators | S | S | S |
| 5.4 - Assessment of Capabilities of Local Steam and Power Generation Equipment Manufacturer[4] | S | MS | MS |

| Performance Indicator | Rating | | |
|---|---|---|---|
| | Relevance | Effectiveness | Efficiency |
| 5.5 – Performance Evaluation of Local Produced Steam and Power Generation Auxiliary Equipment[4] | S | MS | MS |
| 5.6 - Training Course of High Efficiency Equipment Designs and Production Technologies[4] | S | MS | MS |
| 5.7 - Financial Assistance to Local Steam and Power Generation Equipment Manufacturers[4] | S | MS | MS |
| **Rating per criterion for Component 5** | **S** | **MS** | **MS** |
| **Overall rating for Component 5** | **NA** | | |
| | | | |
| **OVERALL RATING FOR THE PROJECT PER CRITERION** | **S** | **MS** | **MS** |
| **OVERALL RATING FOR THE PROJECT** | **MS** | | |

[4] These BioGen activities (Act. 5.4 to 5.7) were rated here as indicated even if they were done through another related project of MGTC, viz. the MIEEIP and were considered to be part of and are relevant to BioGen. Considering that the outputs from the MIEEP project were effectively the same as the expected outputs from the said BioGen activities, it was decided and endorsed by the NSC 5/2005 not to duplicate activities. NSC approved the motion to re-allocate the respective BioGen budgets intended for these activities to the budget for the BioGen FSM-related activities which needed more resources.

### *4.2* Progress Towards Achievement of Outcomes

BioGen is designed to address the barriers in the development and implementation of biomass-based grid connected power generation and CHP in the Malaysian POMs.

Based on the ProDoc, the expected outcomes and performance indicators and what were actually achieved at the end of the project (EOP) are shown in **Table 2** below:

**Table 2: Summary of Outcome Performance Indicators**

| Overall Objective/Outcomes | Performance indicators | Targets by EOP | Actual by EOP[1] |
|---|---|---|---|
| **Overall Objective:** The GHG emissions from power generation in the country are reduced by 3.8% compared to when no interventions are implemented | Percent (%) reduction in GHG emission | 3.8 | PIR 2010: 2.5%<br><br>EOP: 2.67% |
| **Outcomes** | | | |

| Overall Objective/Outcomes | Performance indicators | Targets by EOP | Actual by EOP[1] |
|---|---|---|---|
| Improvements in energy production, savings or installed capacities | Technology (OP6) / approach (OP5) | Biomass-based power generation and POME gas recovery for power generation | Biomass gasification and POME gas recovery for power generation |
| | MW installed (OP6,7) | 353 kW(PI); 18 MW(P2) | 48.7MW |
| | MWh/year delivered (OP6,7) / saved (OP5) | 2,165MWh/year-(P1)<br>110,400 MWh/yr (P2) | 341,290 MWh |
| | Emissions avoided (Mt CO2/a) | 1,300 ktons (P1)<br>66,240 ktons(P2) @ 0.60 kg per kWh | 209,552 mt |
| Expansion of business and supporting services for renewable energy and energy efficiency. | Number of additional businesses with project-related purposes (e.g. Energy Service companies (ESCOs), RE generation, photovoltaic (PV) manufacturers, etc.) | Approx. 100 related businesses in RE. | 53 projects were registered biomass/biogas CDM projects in Malaysia (2005 -2010)<br><br>43 approved SREP projects<br><br>11 certified projects under the Green Technology Financial System<br>(only accessed by websites) |
| Development of sectoral policies, laws and regulations that support project goals. | Development of power sector policies favorable to RE and energy efficiency (e.g. grid access, subsidies, rates and tariffs, taxes, etc.) | 4 policies (pricing, tariff, utilization and alternative financing) | 1 policy but consists of 4 sub-policies (RE policy & action plan covering pricing, tariff, utilization, R&D, and human capital)<br><br>Establishment of Green Technology Policy in 2009 |
| | Scope of influence (e.g. regional, national, etc.) | National | National |
| | Expected additional installation of on-grid RE energy generation capacity triggered by policy changes (MW) | 500–365MW = 165 MW | By 2030, total capacity from RE is targeted to reach 3,484 MW or 13% of total installed capacity (source : RE Policy & action plan)<br><br>10 MP, 5.5% from RE |

| Overall Objective/Outcomes | Performance indicators | Targets by EOP | Actual by EOP[1] |
|---|---|---|---|
| Improvement of awareness and understanding of technologies among producers and users | Type of instrument (e.g. capacity building, etc.) | School, university curriculum<br>Training, workshops<br>Newsletters<br>Website | More than 3,000 industry professionals participated in the workshops/conferences, including nearly 300 mills representatives.<br>100 engineers /technicians participated in the Diploma courses. |

### *4.2.1 BioGen End-of-Project Outcome Metrics versus Targets*

In the absence of a BioGen M&E system (to track the link of project outputs to outcomes), the SREP project approval and monitoring flowchart were presented as it is a system adopted by the government.. The FE team also used the UNDP/GEF PIR reports and other information sources for the evaluation of project outcomes. On the overall outcome, the FE Team made use of the data and statistics about RE projects in Malaysia available from various sources, e.g. project websites, as detailed in Annex I. which included the following:

a. Registered Biomass/Biogas CDM projects in Malaysia (up to Oct 2010)
b. Green Technology Financial System (GTFS) List of Certified Projects
c. Installed Capacity and Number of Applications in Biomass-Related Projects processed through SCORE
d. Statistics of SREP Projects by Fuel Source

The following observations were made in connection with the outcome monitoring based on the said PIRs and illustrated in **Annex J**:

The project used the outcome indicators in monitoring but did not achieve the targeted percentage GHG emission. There were data presented at the outcome-level as “Percent (%) reduction in GHG emission” which has a target and actual values, e.g. for 2008, target was 3.8% and actual was 2.67%, that means not achieving the target level. There was no calculation presented by the Project Team that can back up these figures during the FE process; hence, there is no basis for the actual accomplishments to ascertain whether the project met the EOP Targets for the extended period up to 2008. The annual targets are based on the assumption that Phase 1 was only for 2 years and since the delay of the FSMs, the final EOP output and outcome targets (updated in 2006) were retained as the targets for purposes of PIR reporting from 2006 to 2010. The FE Team noted, however, that the project is incapable to track the actual accomplishment due to the absence of real-time monitoring system. The actual data reported was taken from the consolidation of annual data from the Energy Commission and the National Energy Balance.

The FE team however would like to highlight that as clearly stated in Section F.2. Implementation Arrangement / under Institutional Arrangements, the executing agency (MECM) shall set up the RE program monitoring system. The implementing agency (PTM) to ensure such progress will be monitored accordingly. The FE Team noted that while the Activity-level monitoring is being done by the BioGen’s project team, the linkage between Output-Outcome level monitoring did not appear to be implemented yet. . The FE Team highlighted the importance of the M&E activity not only in fulfilling the UNDP-GEF PIR reporting system but also for purposes of tracking the project impacts after the BioGen project completion. The Annual Targets are supposed to be used for the M&E as these

metrics were started to be monitored in the PIRs as part of all UNDP-GEF project M&E which will serve as basis for the post-project M&E. The M&E process should necessarily be continued and sustained by the designated relevant government institutions.

In addition to available PIR reports and annual targets, the FE Team has supplemented the information provided by the PMO with data and statistics coming from other relevant agencies. The FE Team therefore sees the necessity of coming up with an integrated M&E information system (as a consolidation of existing independent information systems) to be operated and maintained by the designated GoM agency tasked to undertake this important function.

### 4.2.2 *Summary of Outcome Ratings*

In view of the absence of data on the most of the outcome indicators, the assessment of the project performance in the progress of achieving outcomes per outcome indicator listed above cannot be made. Instead, a very general assessment is shown in **Table3** below:

**Table 3: Summary of Outcome Accomplishment Ratings**

| **Objective/Outcomes** | **Results** | **Relevance** | **Effectiveness** | **Efficiency** |
|---|---|---|---|---|
| **Overall Objective:** The GHG emissions from power generation in the country are reduced by 3.8% compared to when no interventions are implemented | 2.5% (PIR 2010; Not verified from an M&E system) | MS | MS | MS |
| **Outcomes** | | | | |
| Improvements in energy production, savings or installed capacities | Gradual increase of biomass and biogas projects over 2004-2009 (Based on SREP, BioGen projects and CDM projects | S | MS | MS |
| Reduction of technology cost trajectories. | (ND) | MS | MS | MS |
| Expansion of business and supporting services for RE and energy efficiency. | (ND) | MS | MS | MS |
| Increase of financing availability and mechanisms | Establishment of REBF (RM 28 million) | S | MS | MS |

| | | | | |
|---|---|---|---|---|
| Development of sectoral policies, laws and regulations that support project goals. | -Passage of the RE Policy and Action Plan<br>-Development and endorsement of RE Act<br>-Tariff uplift tariff RM 0.17 to RM 0.21 /kWh | S | S | S |
| Improvement of awareness and understanding of technologies among producers and users | Strengthening the capacities and knowledge of the MGTC, MEGTW and other related stakeholders and project proponents | S | S | S |
| Overall Project per Criterion | | S | MS | MS |
| Overall Project | | MS | | |

The FE Team noted that the effects of the project activities on strengthening the capacities of the MGTC, MEGTW and other related stakeholders and the palm oil industries cannot be fully established from the data gathered and observation during the evaluation process. There is reason to believe, nevertheless, that the project has s*atisfactorily* met the expectations based on the results of the project as discussed above. The project however has contributed to raise awareness about the use of palm oil biomass/biogas and RE as a whole in power generation and co-generation. The FE Team further noted regarding the current developments of FELDA's program on replicating their FSM experience in their other POMs which is one of the notable impacts of the BioGen (details are seen in **Annex K**).

## 5. ASSESSMENT OF PROCESSES AFFECTING ATTAINMENT OF PROJECT RESULTS

### 5.1. Project Design

The project design as illustrated in its Logical Framework served the purpose of defining the initial stages of work in integrating various basic approaches in removing barriers and demonstrating the viability of biomass/biogas power generating projects in the palm oil industry. As seen in the ProDoc, the crucial role of the 1st FSM in demonstrating initially the said viability depended largely on the actualization of the original 1st FSM (2MW MPOB-Guthrie experimental POM) which was supposed to be relatively attainable. As conceptualized during project development before 2002, it was assumed that this small experimental POM will not have difficulty in serving the purpose as it ushers the use of project funds to support a risk guarantee mechanism for 3 additional demonstration sites with higher power generation capacity than the experimental mill, each with a different mix of parameters that make them a special case, demonstrating the technical viability of new and retrofitted technologies.

The project log frame was retrofitted to allow adjustments in the original targets as part of adaptive management to a certain degree in responding to internal and external changes in the project environment. The non-acceptance by the then new management of the Palm Oil Research Institute of Malaysia (PORIM) MPOB-Guthrie POM to follow the earlier commitment of previous management was a risk that was not anticipated in the PPM. This situation somehow derailed the project at a very early stage during the project inception. Another assumption about a favorable tariff that would have been obtained within the original timeframe of Phase 1 did not happen as expected. The second possible FSM candidate which is the Eko Synthesis Sdn Bhd (in partnership with KOP, or referred to as ESSB-KOP) was unable to proceed further due to uncertainty of the finalized favorable tariff and declined to sign the MOA to be the 1st FSM. Subsequently, all the other candidates waited for a favorable tariff rate so the project dragged on indefinitely until such desirable tariff was approved in 2007. This is the case for a project implementation where most of the activities were completed but the realization of the outcomes is not yet forthcoming. Discounting all other factors that the project has no control of, this assumes that the outputs of the project that should have facilitated an earlier approval of favorable tariffs are all of good quality that the relevant authorities can confidently rely on in coming up expeditiously with a favorable tariff.

### 5.2. Preparation and readiness

The GoM though the MEWC (now MEGTW) and PTM (now MGTC) was prepared and ready to implement the project and had already designated the project team, the project site and the composition of the NSC as mentioned in the Inception Report dated February 21, 2003. The activities started when the Project CTA was hired on January 2003 while waiting for the actual release of funds and completion of the Project Team that happened in March 2003. The Project Team updated the Project Log Frame and the implementation plan. It also reviewed the activities and expected outputs under each project component in terms of content and time frame commensurate with the objectives and the requisite human and financial resources that were expected to be available to the project. It had also considered the prevailing government priorities and policy thrusts considering that the project was being implemented 3 years after it was designed initially in 1999.

### 5.3. Country Ownership/Drivenness

The GoM through its designated government agencies has made RE (including biomass/biogas-based energy projects) as priority for development because of the enormous benefits that will redound to the palm oil industry particularly and the related program beneficiaries. This was later on proven by the government policies, mandates, and guidelines issued to support RE development, though not within the timeframe anticipated by the BioGen Project planning. BioGen has seen its place in the national energy program and the Malaysia 9th Five-Year Plan.

### 5.4. Stakeholder Involvement and Strategic Partnerships

The stakeholders and their roles as stated in the BioGen project design were followed during the implementation wherein most of them participated in the various committees set-up and rendered their services in various activities and their roles in decision making. In the course of project implementation, the partnership strategy did not happen completely for one reason or another. The FE Team observed, however the following:

- Expected inputs from major BioGen project partners were not optimized (as explained later in the co-financing assessment)
- The partnership scheme can be improved

- Direct participation in the decision making and policy formulation process appears useful and facilitated by the project
- There are more opportunities for stronger collaboration and substantive partnerships to enhance the project's achievement of collective results and outcomes of BioGen
- Info sharing among current project partners and stakeholders on project information and progress of activities can still be enhanced. .

### 5.5. Financial Planning

The project has instituted appropriate financial controls, including regular reporting, feedback and planning which effectively allowed appropriate management and timely utilization of the GEF budget. The system used the Annual Work and Financial Plan (AWFP) as the system for programming the financial requirements of the project vis-à-vis the work plan.

The project was subjected to regular and very diligent financial monitoring and a monthly/quarterly reporting system in addition to the annual review under the UNDP/GEF APR/PIR which is only a part of the appropriate M&E system for the project. The government budgetary inputs were subjected to government financial audits by designated government agency. Regular government financial and project management audits were conducted and results disseminated.

### 5.6. UNDP/GEF supervision and backstopping

BioGen has received sufficient supervision and support from the UNDP Country Office in Malaysia and the UNDP-GEF Regional Coordination Unit in Bangkok throughout the project. The UNDP/GEF Regional Technical Advisor and the UNDP Malaysia Program Manager handling the project have been very actively involved and highly effective in providing strategic oversight to the BioGen Project Team, MGTC and NSC considering the problems and challenges the project has encountered in its extended implementation period. Their inputs have been provided in terms of prompt discussion and resolution of identified problems and continuous adaptive management while overseeing the nationally-executed project.

Whenever necessary, intervention, quality assurance assistance and advice were given to the BioGen Project Team to ensure the project's compliance with UNDP/GEF policies and directions consistent with the approved project framework. BioGen has experienced major setbacks that are not immediately the project's scope of management control. It dealt with the factors (external to the project) only to the extent possible in as far as the project can provide inputs and support to facilitate the outcomes. As the FE Team noted, the project outputs and outcomes tended to rely mainly on the natural government pace of tackling issues and priorities. While the project results did not come out at the time and level as expected in project design, they did become relevant to the development of biomass-based projects that eventually started to fall in place in the sixth and seventh years of BioGen, much later that it has aimed for.

### 5.7. UNDP/GEF Funding and Co-Financing

**Table 4** below summarizes the performance in terms of the delivery rate in project funds.

**Table 4: GEF and Co-Financing Delivery Rate**

| Source | Approved as per ProDoc | Additional funding after ProDoc | Total Available funding | Actual as of Sept 2010 | Delivery Rate Actual/ Available |
|---|---|---|---|---|---|
| **GEF** | 4,000,000 | | 4,000,000 | 3,985,896 | 99.9 |
| **CO-FINANCING** | | | | | |
| **Cash** | | | | | |
| Government | 3,025,600 | 950,000 | 3,025,600 | 3,537,786 | 116.9 |
| Private Sector | 6,518,500 | | 6,518,500 | 23,131,579 | 354.86 |
| ***SubTotal*** | 9,544,100 | | 9,544,100 | 26,669,365 | 279.45 |
| **In-kind** | | | | | |
| Government | 804,820 | | 804,820 | 1,909,920 | 237.3 |
| Private Sector | 385,270 | | 385,270 | 589,473 | 153.0 |
| ***SubTotal*** | 1, 190,090 | | 1, 190,090 | 2,499,393 | 210.0 |
| **SUB- TOTAL Co-financing** | 10, 734,190 | | 10, 734,190 | **29,168,758** | **276.1** |
| **GRAND TOTAL** | 14,734,190 | | 15,684,190 | 33,154,654 | **211.0** |

The details of the performance in GEF Fund and Co-financing are seen in **Annex L.** The following are the important information from the data gathered:

- GEF fund utilization is 99.4% as of the FE period at the UNDP/GEF level. At the project level, about USD 7.6 million (RM 23 million) remains unspent as a trust account in Bank Pembangunan which was intended for BioGen project loans. This fund is being recommended by this FE to be used for the same purpose that it was intended originally by the Government of Malaysia under an appropriate mechanism and through an authorized agency that will carry out the implementation of the RE program as a government priority.

- Perunding AME Sdn Bhd. (by virtue of tender committee endorsement on 28 Feb 2005) was appointed to be the FSM consultant to expedite the development of FSM at the same time act as the consultant to assist in the delivery of the outputs of the other project components. The budget approved under this consultancy was RM 3.2 million, which were derived from the reallocation the original remaining budget for the local and international experts, as well as the budget of the activities in BioGen Component 5, particularly from Activities 5.4 to 5.7. The outputs and requirements of these activities were deemed to be the same as for another UNDP-GEF project, the MIEEIP project of GoM. The original budget for these activities was re-allocated to cover for the combined related activities of BioGen and Component 7 of MEEIP. This proposal was endorsed and approved at the 5th NSC meeting on 21 March 2005 as a change of project approach. A request for endorsement for the payment to the consultant was presented by the CTA to the Project Director on 26 May 2005 further documenting the reallocation of original budget for FSM Consultant contract.

- Additional co-financing of USD 950,000 was provided to the REBF fund.

- GEF money amounted to RM 9 million and AAIBE (Malaysian Electricity Supply Industries Trust Account (MESITA)) was RM 5 million. BPMB placed RM 14 million as counterpart to said financial inputs to have the total of RM 28 million for REBF.

- The REBF allocation amounting to RM 5 million (USD 1.3 million) was released for MHES Biomass FSM.

- FELDA Biogas FSM did not avail of the RM 9 million from the REBF.

- Remaining available REBF fund is RM 23 million (including BPMB's RM 14 million and GEF's RM 9 million – biogas portion mainly). The RM 5 million loaned to MHES came from the MESITA fund. GoM may decide what to do with these funds consistent with Project objectives such as funding for the studies for the remaining technical issues on the FSM, funding for project preparation to produce quality feasibility studies and funding for back-up loan guarantee fund and other financial schemes to support biomass/biogas projects under the supervision of a proposed central agency to be designated to carry on the bigger agenda of national RE program including biomass/biogas power generation and other RE initiatives.

- Amount of cash and in-kind co-financing exceeded the expected commitments in the ProDoc at 276%.

After including co-financing from cash contribution from 2 FSMs as investments by Host Companies (the total project cost for MHES was RM 80 million and for FELDA Biogas plant was RM 7.8 million), the overall result in total expenditures compared to the amount that was declared as budget in the ProDoc for the demonstrations at 211%.

However, the FE Team noted that some of the cash co-financing commitment from other stakeholders, e.g., FRIM, MIDA, MPI, etc. did not meet the target as expected in the ProDoc commitments. At this point, the FE further noted that there are no agreements which were carried out to formalize their commitment as agreed during the project design.

### 5.8. Timeliness of Project Outcomes and Sustainability

The project is now in its seventh year since the project inception meeting in February 2003. Based on the original ProDoc timetable, the project had effectively three extensions of the closing dates: i.e., 31 December 2004, 31 December 2007 and 30 June 2010.

FE noted that the ultimate cause of the Phase 1 delay was due to selection of suitable FSM site, which was brought initially by the inability of the experimental MPOB-Guthrie as the first FSM and this was exacerbated further by weak responses by private developers to enter such venture. The experience in the first FSM could have been used as the showcase in establishing the viability of the biomass/biogas technologies and for the policy making to be influenced accordingly. It cannot be concluded that the delay in the demonstration of the 1$^{st}$ FSM has caused the delay in the adoption of favorable policies and tariffs in RE projects which were being clamored by the potential host companies. As stated above, discounting all other factors that the project has no control of, this assumes that the outputs of the project that should have facilitated an earlier approval of favorable tariffs are all of good quality that the relevant authorities can confidently rely on in coming up expeditiously with a favorable tariff.

The policy making and the legislative processes of the government have their own cycles and lead times that can only be assumed to be realized depending on the prevailing

policy and priorities of the government. The project design anticipated an opportunity for the GoM, using the project as a vehicle, to influence the government process. This was supposed to be with the resultant effects of the project in terms of demonstration of viability of the technologies, knowledge build-up for the industry and capacity strengthening of the organizations involved using the 1st FSM experience, and results from other project components. However, FE noted that the government process is clearly beyond the immediate circle of influence of the project. That means, under the adaptive management approach, this external factor is considered to be a risk that can be overcome through an effective collaboration of the government with the major palm oil industry players. NSC should have played a stringer role, exerted more efforts, singly and collectively, under a more strategic arrangement in achieving common project goals.

In protracting the next steps and learning from this experience, a central body with more defined mandate and responsibility of leading and influencing the development, planning, implementing, supporting, monitoring and evaluating RE projects should already be undertaken by the GoM at the program level to sustain the BioGen initiatives.

Up to the present, the two FSMs have still not been fully operational and they are expected to be fully completed in 2012 and may even stretch up to 2013 if the pending technical problems (including interconnection issues) faced delays during rectification process. For FPI, it is envisaged that interconnection will be the only remaining hurdle while for MASB, major rework on fuel feeding systems are needed. FE noted that the full completion is beyond the authority of the project team as these are private-sector projects. It is however, expected that they will continue to complete the process and for MASB, it will be monitored under the normal banking regulation which repayments are being expected according to the loan covenants.

### 5.9. Project Sub-contractors and Delivery of Outputs

The deliveries of the sub-contractors and consultants have met project expectations and contributed to the achievement of the planned outputs. The details were discussed in **Section 3.2** above.
In general, the outputs by these activities and sub-components contracted out to co-operating agencies and service providers were of satisfactory quality and were very useful for the project.

### 5.10. Project management (adaptive management framework)

In terms of the adaptive management framework, the project has sufficiently adapted to the changing situations and implementation difficulties, i.e., whether challenges or barriers, which were not expected in the project design and/or at the start of the project. The elements of organization and management practices were discussed in detail in Section 3.1. Based on the project circumstances, the project experienced major setbacks beyond the control and immediate scope of the project team. Continuous efforts were sought, relevant steps were identified and the approaches for the solutions were considered though not implemented effectively because of prevailing uncontrollable external factors.

One of the adaptive management that was done by the PMO is the retrofit of the project planning matrix (PPM), and the subsequent adjustment of the Annual Targets. The PIR 2005 has used this updated set of indicators and targets. These changes served to clarify the expected outputs of the updated activities. The FE Team observed that this adaptive management was effective. However, the FE Team observed further that subsequent PIRs did not use anymore the complete updated PPM indicators and targets

due to some changes in the PIR format. The revised targets served as basis for monitoring during the extended period of the project from 2006 to 2010.

## 6. ASSESSMENT OF RISKS TO SUSTAINABILITY OF PROJECT OUTCOMES

At time of evaluation, generally, the sustainability of the outputs of the project to continuously result to the desired project outcomes was in doubt. This is based on the observations on the progress of barrier removal activities and the results achieved so far by the project and the status of activities at the time of the FE.

### 6.1. Original Definition of Barriers and Status of Barrier Removal

As experienced by the project, implementation difficulties, i.e., whether issues or barriers, were identified in the ProDoc in the project design and validated at the start of the project during the inception phase. The approaches for the solutions were considered and implemented. **Table 5** presents these including the status of the barrier removal achievements of the project.

**Table 5: Status of Barrier Removal**

| At Project Start | Interventions by the project | Results as of December 2010 | Status of Barrier Removal |
|---|---|---|---|
| Lack of Information Services to Promote Biomass Energy | Biomass One-stop-Center (BOSC)<br><br>Database/website established<br><br>Info materials and dissemination | System in place but not integrated at business level, decision support systems needed<br><br>A dedicated agency to take the lead for OSC yet to be set up and functioning<br><br>No sustained effort to promote BioGen was observed | Partially removed; to be sustained by a designated central RE agency<br><br>More promotional efforts will be organized under green technology and climate change mitigation efforts as stated in 10MP |
| Absence of Policies on Biomass Energy Technology Development and Applications | RE Policy and Action Plan including establishment of RE Act recommended | Prepared and endorsed<br>Pending final enactment of RE Act | Completely removed |
| Lack of Accessible and Favorable Financing Schemes | Info dissemination to banks including public/private sectors<br><br>REBF Facility established. | Banks still risk-averse<br><br>Technical reliability still doubted<br>GTFS launched, yet to see success stories | Still existing; with success in supplemental funding schemes being put in place could be completely removed |

| At Project Start | Interventions by the project | Results as of December 2010 | Status of Barrier Removal |
|---|---|---|---|
| | A step up approach from REBF to innovative guaranteed financing by Green Technology Funding Schemes (GTFS)<br><br>Other windows for generic projects<br><br>Feed-in-Tariff (FiT) to be introduced which was initiated by UNDP/GEF BIPV project | CDM plays key role in existing projects<br><br>FiT yet to be introduced (to be enforced with RE Act) | |
| Lack of Information Services to Promote Biomass Energy | Biomass One-stop-centre (BOSC) including support to CDM biogas projects.<br><br>Database/website<br>Info materials & dissemination | System in place but not integrated at the business level; decision support systems needed<br>A dedicated agency to take the lead for OSC yet to be set up<br><br>No sustained effort to promote BioGen observed | Partially removed; to be sustained by a designated central RE agency.<br><br>More promotional efforts will be organized under green technology and climate change mitigation efforts as stated in 10MP |
| Absence of Policies on Biomass Energy Technology Development and Applications | RE Policy and Action Plan including establishment of RE Act recommended.<br><br>Feed-in-Tariff (FiT) to be introduced which was initiated by UNDP/GEF BIPV project | Prepared and endorsed<br><br>Pending final enactment of RE Act | Partially removed; to be sustained by a designated central RE agency.<br><br>Efforts will be organized under green technology and climate change mitigation efforts as stated in 10MP |
| Uncertain Financial Viability | Comprehensive feasibility study completed<br><br>FSM as the pilot projects<br><br>RE Policy and Action Plan including | Lack of high quality feasibility studies to guide decisions<br><br>Lack of success full scale plants<br><br>FiT yet to be in place | Partially removed; to be sustained by a designated central RE agency |

| At Project Start | Interventions by the project | Results as of December 2010 | Status of Barrier Removal |
|---|---|---|---|
| | establishment of RE Act recommended.<br><br>Feed-in-Tariff (FiT) to be introduced which was initiated by UNDP/GEF BIPV project<br><br>Local banking capacity development<br><br>Bank familiarity with technology | Expensive technology, lack of local skilled personnel<br><br>Bankers still in doubt | |
| Lack of Successful Models to Demonstrate the Viability | FSM on Biomass<br>FSM on Biogas | Although the number of projects had increased over the years under SREP, there are still lack of successful full scale projects | Partially removed; to be sustained by a designated central RE agency<br><br>Intensive efforts will be organized under the ETP EPP No 5 |
| Uncertainties of Biomass Fuel Supply | Selection process on fuel availability and distance completed.<br><br>Long term fuel supply agreement recommended.<br><br>Regulated market price for biomass /biogas recommended. | Difficult to secure biomass resources with short transportation and meeting the economics of scale and power demand. A major challenge to find suppliers willing to commit long term e.g. > 5-10 years<br><br>Uncontrolled pricing which leads to escalating biomass fuel price, speculated market | Partially removed; to be sustained by a designated central RE agency<br><br>Intensive efforts will be organized under the ETP EPP No 5 |
| No Incentive to Recover and Use POME-Biogas for Power Generation | Recommendation on subsidy review on fossil fuel and incentive for POME biogas power e.g. Feed-in-Tariff (FiT) to be introduced which was initiated | Still a barrier causing non level playing field, but government moving towards removing it gradually<br><br>FiT yet to be | Partially removed; to be sustained by a designated central RE agency<br><br>Intensive efforts will be organized under the ETP |

| At Project Start | Interventions by the project | Results as of December 2010 | Status of Barrier Removal |
|---|---|---|---|
| | by UNDP/GEF BIPV project<br><br>Reviewed and improved REPPA conditions e.g. remove performance target | introduced.<br><br>Already achieved through the VSREP | EPP No 5 |
| Uncertainty of Power Purchase by TNB Distribution | RE Policy and Action Plan including establishment of RE Act recommended.<br><br>Feed-in-Tariff (FiT) to be introduced which was initiated by UNDP/GEF BIPV project<br><br>Subsidize interconnection cost | RE Act yet to be enforced<br><br>FiT yet to be introduced to improve viability | Partially removed; to be sustained by a designated central RE agency |

Based on the above, a government program to continue to pursue barrier removal and encourage more RE projects is needed if the original goals of BioGen will be achieved fully. The implementing capacity of a lead agency needs to be established first in terms of managing the above-mentioned management risks, barriers and other operational factors.

The earlier decision not to pursue Phase 2 of the BioGen Project as designed in the ProDoc has proven to be pragmatic considering the changing situation not foreseen in the original baseline conditions from which the project was designed. Nevertheless, the outputs of Phase 1 are still very useful as the biomass/biogas experience in Malaysia has gathered more momentum in tapping the large potential in the palm oil industry as seen in the increasing number of RE/biomass projects. In the light of these very positive indications, a follow-up project can be carried out that will build upon the gains made in the past years and updating the RE development framework considering recent developments and evolving government strategies in the RE program and institutional strengthening.

On the policy front, FE team noted the broad policies introduced in the 10 Malaysia Plan (2010 – 2015) where RE generation will be increased from less than 1% in 2009 to 5.5% of Malaysia's total electricity generated by 2015. It is expected that biomass and biogas will contribute up to 300MW and 100 MW generating capacity respectively. Further, RE projects announced in the Entry Point Projects (EPP) no 5 under the Economic Transformation Programme (ETP) 2010 proves that BioGen outputs are indeed able to be replicated and adopted by the industries.

## 6.2. Project Results in Relation to Sustainability of Outcomes and other Short/Long-term Consequences

Directly or indirectly, the BioGen has also influenced short and long term consequences brought about by the project results described above In view of the results discussed in the foregoing sections above, this section aims to present factors to sustainability and evaluate the likelihood of sustainability of outcomes at project termination. This refers to the likelihood of continued benefits after the BioGen project ends as planned. **Table 6** presents the FE observations that could affect sustainability of outcomes for the project in general and by components.

**Table 6: Assessment of Project Results in Relation to Sustaining Outcomes**

| Project Components | Assessment of Project Results in Relation to Sustaining Outcomes |
|---|---|
| Project in General | • The biomass/biogas demonstration through the 2 FSMs are not yet fully operational, thus, the objective of show casing viable technologies has not been achieved. After the project ends, the FSM Host Companies will have to continue their respective projects under the financial circumstances and obligations, particularly for MHES in the aspect of loan repayment.<br>• The passage of the RE Policy and Action Plan, the expected enactment of the RE Act and the uplift of tariff to RM 0.21/kWh in 2009 from the RM 0.17/kWh level since 2006, has resulted from BioGen (with the Malaysia Building Integrated Photovoltaic (MBIPV) project) and will continue to produce results of encouraging more biomass/biogas projects and RE projects as a whole.<br>• The adoption of the REPPA (as revised) which was applied for the FSMs under the SREP has continued to be used by other projects which include also the applicable uplifted tariff.<br>• The awareness, information, training conducted, capacity building, barrier removal and the overall promotion through BioGen and other related projects has collectively developed the momentum of encouraging not only biomass/biogas projects but also RE in general for the country, because of which, a gradual increase of biomass/biogas projects over 2004-2009 have been observed.<br>• FE team noted the broad policy introduced in the 10 Malaysia Plan (2010 – 2015) where RE will be increased from <1% in 2009 to 5.5% of Malaysia's total electricity generated by 2015. It is expected that biomass and biogas will contribute up to 300MW and 100 MW generating capacity respectively. Further, RE projects announced in the Entry Point Projects (EPP) no 5 under the Economic Transformation Programme (ETP) 2010 proves that BioGen outputs are indeed able to be replicated and adopted by the industries. EPP plans for more biogas plants to be developed over the next 10 years. Of these, 250 mills will target to supply electricity to the national grid by 2020 and another 233 mills will capture biogas to be used as fuel for their own boilers. |
| Component 1 - Biomass Information and Awareness Enhancement | • The overall sustainability of the key outputs appears to be in question.<br>• During the FE, the BioGen web portal (main output) was not available on-line due to technical problem with the new website after PTM was reorganized to MGTC. The web portal has not been updated and actively used.<br>• The BRIS was observed to be in place and functioning. There is no sustainability plan to update data. |

| | |
|---|---|
| | • Sustainability of some of the outreach activities such as publication of newsletter, monitoring of selected projects, etc. were not demonstrated. |
| Component 2 - Biomass Policy Study and Institutional Capacity Building Program | • The key outcome from this component is the adoption of the simplified REPPA model as well as the passing of the RE Policy and Action Plan<br>• The Renewable Energy Act and its implementing rules when enacted can ensure sustainability of the program<br>• The proposed setting up of an overall agency may be an answer to the lack of overall coordinating agency. |
| Component 3- Biomass Initiatives Financing Assistance Program | • Overall, the financing facility via REBF was successfully set up (despite the delay) but the impact and effectiveness was not achieved.<br>• The introduction of the Green Technology Funding Scheme in 2010 presents another financing support from GoM but the impact is yet to be seen. About 10 palm oil biomass/biogas projects had applied under this funding scheme |
| Component 4- Biomass based Power Generation and CHP Demonstration Program | • The FSMs were supposed to be the show cases for replication of projects. Due to various technical issues, this outcome was clearly not met over the lengthy project extension period.<br>• The lack of success cases clearly highlighted in many open fora, e.g., the National Palm Oil Small Renewable Energy Program Seminar held on 11th March 2010 in KK, Sabah.<br>• Despite not having to achieve the full design operating capacity, the FSMs have demonstrated removal of the various barriers in implementing the two types of projects which can be used as "lessons learnt" for any future projects to be initiated. |
| Component 5 - Biomass Energy Technology Development Program | • The study on energy and non-energy usage highlighted the potential competition of biomass residues need to be updated.<br>• The energy audits provided an approach towards identification of energy management improvements in POM and can be done for the other mills.<br>• The technology development impact was not fully assessed as it was done under another project (MIEEIP) |

### 1.3 Likelihood Ratings of Factors that Could Affect Sustainability of Outcomes

Given the uncertainties involved, the assessment of sustainability of outcomes includes an analysis of the risks that are likely to affect the persistence of project outcomes as the project ends as planned as shown in **Table 7**. On a per-dimension analysis basis, only those outcomes (discussed in **Section 4.3** that can be directly affected by the dimension were assessed (in terms of pertinent aspect involved) as included below and rated using guidelines in **Annex C**.

**Table 7: Likelihood Ratings of Factors that Could Affect Sustainability**

| Sustainability Dimension | Outcomes (in terms of) | Rating |
|---|---|---|
| Financial Resources | Improvement in energy production, savings or installed capacities (in terms of capital investments in power plants) | Moderately unlikely |
| | Reduction of technology cost trajectories (investment in improving manufacturing biomass/biogas facilities) | Moderately unlikely |
| | Expansion of business and supporting services for renewable energy and energy efficiency (capital for service industries) | Moderately unlikely |
| | Increase of financing availability and mechanisms | Moderately |

| Sustainability Dimension | Outcomes (in terms of) | Rating |
|---|---|---|
| | (terms and conditions favorable to biomass/biogas projects) | likely |
| | Improvement of awareness and understanding of technologies among producers and users (budget for additional follow-up activities in sustaining capacity building, information services and promotion) | Moderately likely |
| | Change in consumption, fuel-use patterns and impacts on end users (investment in fuel logistics and energy conversion facilities) | Moderately unlikely |
| Socio-political | Improvements in energy production, savings or installed capacities (incentives and further removal of barriers thru SREP and other related programs) | Moderately likely |
| | Development of sectoral policies, laws and regulations that support project goals (firming up of implementing rules and effective monitoring and evaluation for results) | Moderately Likely |
| | Improvement of awareness and understanding of technologies among producers and users | Moderately likely |
| | Change in consumption, fuel-use patterns and impacts on end users (national policy and implementation of Energy Act) | Likely |
| Institutional Framework and Governance | Improvement in energy production, savings or installed capacities (integration of related functions into a central administrative and implementing agency) | Moderately Likely |
| | Reduction of technology cost trajectories (support technology development programs and institutional strengthening and R&D). | Moderately unlikely |
| | Expansion of business and supporting services for renewable energy and energy efficiency (capacity building for support services and technical consultancy) | Moderately unlikely |
| | Increase of financing availability and mechanisms(more banks to support with favorable terms and conditions) | Moderately likely |
| | Development of sectoral policies, laws and regulations that support project goals (establishment of a central body to oversee RE, including biomass/biogas projects, and M&E) | Moderately unlikely |
| | Improvement of awareness and understanding of technologies among producers and users (follow-up information and promotion program by relevant institutions) | Moderately likely |
| | Change in consumption, fuel-use patterns and impacts on end users (capacity building for institutions and M&E) | Moderately unlikely |
| Environmental | GHG emission reduction (policy support and M&E) | *Moderately unlikely* |
| | Development of sectoral policies, laws and regulations that support project goals (implementing rules and sanctions) | *Likely* |
| | Improvement of awareness and understanding of | ~~*Moderately*~~ |

| Sustainability Dimension | Outcomes (in terms of) | Rating |
|---|---|---|
| | technologies among producers and users (information services, promotions and M&E) | *likely* |
| | Change in consumption, fuel-use patterns and impacts on end users (technologies that are effective in GHG reduction) | *Moderately unlikely* |

To the extent possible, the project can only draft policies and monitor the adoption and issuance of policies. The final enactment and enforcement of implementing guidelines therefore depend on external-to-project conditions. The implementation of palm industry biomass energy (or RE in general) policy solely depends on the cabinet approval to address all issues i.e. pricing, policy and regulation, promotion, R&D, etc.

On the financial aspects, the risks still lie on the risk-averse posture of banks towards unproven technologies though they claimed by developing as nearing commercialization already, such as palm industry biomass and biogas for power generation. The project fund allocation for the REBF was not used completely as planned and maybe viewed by the banking sector as not necessary or there are no qualified borrowers for that matter. Considering this project experience in terms of the non-fulfillment of the desired financial participation, the expansion/replication of the RE Business Facility in BPMB and to other banks may meet certain obstacles. This will expectedly limit the ability to sustain biomass-based RE financing in Malaysia.

On the institutional framework and governance, there is a need for a central government agency to oversee the implementation and monitoring or results for RE and sustainable mechanisms to realize the desired outcomes and impacts.
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## 7. OTHER ASSESSMENTS

### 7.1 Catalytic Role of BioGen

The BioGen Project started activities which were hoped to catalyze the development of numerous biomass and biogas projects to tap the big biomass potentials by demonstrating their operational and financial viability through the FSMs. This role however was not fully fulfilled by the project because the FSMs were not operated within the extended timeframe of the project up to 2010. Hence, catalytic or replication effects cannot be ensured immediately if the FSM's operational experience will be used as basis by prospective companies in planning and deciding on biomass/biogas projects. Nevertheless, strong awareness is presence among the millers was realized directly due to impact of the project activities. FE team noted that FELDA is pursuing a company program on replicating their FSM experience in their other POMs which is one of the notable impacts of the BioGen (details are seen in **Annex K**). The long-term impact to the national policies (10 Malaysia Plan and ETP) have mentioned in Table 6: Assessment of Project Results in Relation to Sustaining Outcomes.

### 7.2 Assessment of BioGen M&E System

This part of the evaluation assessed whether the project met the minimum requirements for project design of M&E (minimum requirement 1) and the implementation of the project M&E plan (minimum requirement 2) of the GEF Monitoring and Evaluation Policy.

#### *7.2.1 Project M&E System*

The FE Team found the BioGen Project at the beginning used Microsoft Project software in its monitoring of project activities outputs. Later on, this system was used to a lesser extent because it cannot provide a sound basis for monitoring results and track progress toward achieving project objectives and outcomes. The PMO was not able to present to the FE Team an M&E plan that presents a baseline (including data sets, gathering, methodology, and report formats), indicators, and evaluation studies periodically done to assess results. The timeframe for various M&E activities and standards for outputs were also not adequately specified.

The BioGen Project Team only relied primarily on the UNDP/GEF's M&E reporting tools such as AWP and APR/PIR (with assistance from the UNDP Malaysia Country Office) for monitoring project progress but the output-outcome linkages to ascertain project impacts were not fully explored mainly due to challenges faced in achieving the outputs. It was also observed due to the absence of a concrete real-time monitoring plan on RE, data gathering remained ad hoc and preparation of the said reporting requirements of UNDP and GEF become difficult and oftentimes present inconsistent and unclear basis of monitoring results and tracking progress in achieving the BioGen outcomes and objectives.

Documentation submitted to FE is mainly on the overall SREP development circle and how it is interlinked to the overall national policies and the role of SCORE but the said monitoring plan is yet to be seen. It was noted that such initiative will be developed further in the 10MP. Due to this deficiency, the outputs cannot be logically related to expected outcomes. The FE Team also requested the methodology and assumptions used for calculating the numerical values of the project outcome metrics included in the APR/PIRs but these were available during the FE process to have some basis for assessing the procedures involved.

### 7.2.2 *Implementation of M&E System*

The FE Team observed that project M&E policy, system and institutional arrangements have not been established to facilitate the timely tracking of progress toward project objectives. The sustained collection and analysis of data and information on the project accomplishments (direct and indirect results) using the agreed indicators was not demonstrated in the FE, though the project has always referred to the Annual Targets as a tool for monitoring the performance in the annual APR/PIRs.

The adjustments of the indicators and annual targets in June 2004 in connection with the updating and retrofitting of the project planning matrix (PPM) was meant to improve the monitoring of the project progress and evaluating the project achievements. The revisions in the PPM served to clarify the expected outputs of the updated activities. The PPM retrofit was done as an adaptive management measure to improve the project implementation by the BioGen Project Team. The updated set of indicators and targets were first used during the PIR 2005 reporting exercise. The FE Team observed that this adaptive management was effective. However, the FE Team observed that subsequent PIRs did not use anymore the complete updated PPM indicators and targets due to some changes in the PIR format. A data gathering system based on the revised indicators was not evident during the FE process. Such system should have completed the M&E system implementation particularly in measuring the outcomes and impacts of the project.

An M&E system should have been helpful in preparing and completing APR/PIRs reports each year and in making data readily available and consistent. The

preparation of PIR reports could have been facilitated from information that can be derived from an M&E system. In so doing, there could be sufficient basis for the project management to improve performance and to adapt to changing needs and priorities on a regular basis. As such, there is a need for a specific group with proper training to be responsible for the necessary M&E activities and to ensure that the data will be sustainably collected and carried through after project termination. Specific budgeting and funding for an integrated and dedicated M&E system consequently should also be supported. The FE Team, however, noted that there are isolated monitoring of energy-related activities among agencies such as Energy Commission, MGTC, MPOB and Department of Energy but only with reference to their own administrative and governmental functions and not linked to each other to give an integrated system at the national level. Related independent monitoring and evaluation activities are seen in BRIS, SCORE, MGTC and MPOB monitoring systems which can be integrated. FE Team rated the performance on M&E as Marginally Satisfactory (MS)

### 7.3 Monitoring of Long-Term Impacts

Similarly, the M&E of long-term changes which is often incorporated in GEF-supported projects is also not evident in BioGen yet. This is definitely needed to be institutionalized in a proper institutional structure with the necessary policy mandate, budgeting and organizational support which could be made possible through a designated central agency which may be established by GoM.

## 8. CONCLUSIONS

a. Overall, BioGen was well-placed and integrated within the national government development strategies. The inputs and recommendations from BioGen were instrumental to the uplifting of more favorable tariff, better REPPA conditions as well as the ultimate preparation of RE policy strategies and RE Act.

b. Except for the two (2) FSMs, all expected outputs have been delivered in the first 4 years (2003 – 2007) of the project which was originally for three (3) years. Outputs for 2008 – 2009 are basically involved in the FSM commissioning (because original hosts did not materialize) and outputs for 2010 are mostly monitoring of the completion of the installation and operation of the FSMs to be able to sell power to the grid as planned. In the PIRs, and validated during the FE process, there were project activities that were re-programmed for Phase 2. But since there will be no more Phase 2 for BioGen, those activities can be continued in another project and/or be absorbed by a new designated government agency. There were also some activities that were absorbed by the Malaysian Green Technology Corporation (MGTC, formerly PTM) in its regular functions.

c. The basic policies and a pending enactment of the RE Law and applicable tariffs have been achieved which consist the most important achievements attributable to the project.

d. The RE industry now enjoys a higher tariff of RM 0.21/kWh as it clamored for. The RE Law which is expected to be passed by parliament will further provide the needed institutional, financial and other important supports.

e. There is still the lack of an agency which is authorized to integrate the various activities in biomass and RE in general and take leadership role in pursuing the program management and linking all the outputs of the project and all other related

projects and activities into the desired outcomes of the Program consistent with GoM goals and priorities. The FE team sees the need for such a central agency. The Ministry of Energy, Green Technology and Water has plans towards this direction also.

f. It appears that the project has not completed documenting an M&E system to be followed in linking Outputs to Outcomes using a system which is established and documented in a computer-network-based platform. The BioGen Project Team has mentioned in its PIR reports that the monitoring and evaluation work will be done in Phase 2, but this will not be pursued anymore. The FE Team sees the critical need for an M&E system to define the indicators, performance targets and how to keep track of progress during implementation.

g. It appears that the organizational, management arrangement and leadership role on the project implementation can be strengthened further to carry out the project activities and tackle the challenges which have affected the timely and effective project performance especially when there was difficulty in imposing commitments in the project inputs and the needed co-operation in a partnership strategy desired in the project. But since the project has ended already, the areas of improvement can be considered in forming the central agency for biomass/biogas under the overall RE program.

h. Operation and demonstration of the FSMs will have to continue on their own. The biomass FSM only operated for 15 days and therefore needs to be rectified in the fuel handling systems and furnace stability. The biogas FSM has been operating and delivering 300 KW with sufficient gas to support the designed 500kw but needs to upsize the interconnection cable to fully achieve its goals.

i. The overall assessment rating of the project is Marginally Satisfactory (MS).

## 9. RECOMMENDATIONS

1. <u>Implementation of remaining project activities towards achieving desired outputs/ outcomes</u>

   a. *Updating of the need and relevance of remaining project activities considering current GoM policy thrusts and goals and integrate them with new necessary activities in the context of a program and strengthened organizational structure*. Since the project is being considered to be closed, implementation of remaining activities will no longer be possible within the same project arrangements. A new logical framework with updated indicators of success and targets will be necessary.

2. <u>Project activities and/or deliverables that may have to be rectified or improved in order to bolster the realization of project outcomes</u>

   a. *Continuation of the task that BioGen has started to do in overseeing the development, implementation, monitoring, evaluating, facilitating and tracking biomass projects by an authorized agency for biomass/biogas projects in Malaysia.* Under the present organizational set-up of the Ministry of Energy, Green Technology and Water (MEGTW), there is still no such agency to carry out the biomass/biogas program which could be on a broader context of renewable energy due to common needs and stakeholders involved. A strategic review of the appropriateness of PTM as prescribed in the BioGen ProDoc (now the Malaysia Green Technology

Corporation) to perform this role is further recommended as said task may not be compatible with the MGTC's current thrusts.

b. *Establishment and operationalization of an integrated coordination mechanism and policy harmonization at the institutional level among agencies involved should be established under the leadership of an authorized agency to meet GoM's energy goals*. Considering the BioGen Project experience and lessons learned and the current GoM policies, the integration under the proposed authorized agency should be equipped with strong policy and responsibility mandate, institutional coordinating ability, budget resources and well-defined programs and targets.

c. *Integration of the database systems existing in different authorities and agencies involved in biomass (or RE in general).* This is crucial if integration of related programs and projects is desired. This will involve the establishment of a system for information exchange and network linkages among participating entities under the leadership of the authorized agency and supervised by MEGTW at the national level.

d. *Installation of a project data gathering, monitoring and evaluation by the MEGTW about project achievements among participating institutions and agencies under an adopted M&E policy with appropriate institutional and budgetary supports to sustain it.* As such, the monitoring and evaluation function of the project will not be affected by staff turnovers and can be institutionalized and sustained in an appropriate regular government agency designated to oversee the program after the BioGen project ends.

3. Follow-up activities that will be carried after the project

a. *Firming up by the MEGTW in coordination with all stakeholders of the realistic share of biomass in the Malaysia national energy mix and the Energy Action Plan to achieve it in the light of the BioGen project results.* The biomass contribution in the RE Policy targets should be defined to become the basis of a deliberate policy to install and operate projects and sustain a biomass/biogas program with an M&E system at the national, state and local levels.

b. *Validation of the technical design and improvements on the two FSMs and the corresponding financial feasibility of the proposed improvements considering operating experience.* This will aim to resolve current technical issues on the FSMs, particularly on the first FSM on biomass-based power plant through commissioning a technical evaluation task force that can be created by MEGTW with assistance of MGTC to recommend measures to resolve the issues within an agreed timeframe (say 3 months). This will also help BPMB to decide on the future revenue possibilities for MASB in connection with the MASB loan from the REBF. Expenses can be charged to the remaining project REBF GEF budget and within the purview of the BioGen Project objectives to demonstrate ready technologies. Since the project will officially end by December 2010, MEGTW can be directly involved.

c. *Determination by MEGTW and MGTC of an EFB reference price based on fuel parity and non-energy usage to arrive at a certain reasonable margin as a fuel shift incentive*. Considering the increase in competitive usage of biomass fuel and subsequent escalation of biomass price, government intervention is essential in order to stabilize the fuel cost for biomass-related projects. Such benchmarks can be very useful in the design of future biomass projects.

d. *Utilization of the remaining REBF funds should look into the original purpose for which it was intended to serve*, e.g. an innovative loan/grant mechanism and facility

that will be worked through the Malaysian banking sector to soften the risks involved in the biomass/biogas-power generation technologies. Part of the REBF can be utilized as project preparation window using a revolving fund to support potential BioGen developers in conducting detailed financial, technical and market feasibility studies of their projects in support of said mechanisms. Since the BioGen Project is now closed, this utilization scheme will be under the auspices of the GoM under MEGTW, or when feasible, through the newly designated authority to oversee the biomass/biogas projects, under a broader RE program. In order for the scheme to be relevant and effective, a new set of guidelines can be developed with BPMB to cover this proposed scheme to develop a pipeline of projects that can be supported by the REBF.

## 10. LESSONS LEARNT

1. The need for an overarching RE program is crucial during the project implementation. With a stronger final objective the project partners can exert more efforts, individually and collectively especially in strengthening inter-agencies coordination under a more strategic partnership arrangement in achieving common project goals and executing agreed plans in the ProDoc.

2. Official MOAs that define more specific project management arrangements are necessary to implement the project more effectively and derive sustained commitment in achieving outputs that are clearly linked to the project's desired medium to long-term outcomes. In managing project of this size, combining the roles of the CTA and the overall Project Manager into one person may not be effective in performing the critical functions of project management and provision of technical advice at the same time. Project manager's role shall include managing day-to-day project progress including inter-agencies coordination and while a CTA shall look into the FSM completion, power generation and interconnection issues. The project organizational design did not include an overall Project Manager in the organization. Moreover, the NPD as top executive of the Executing Agency would have to attend primarily to high level management matters of the project. Therefore, considering the size and scope of the project, it needed an overall Project Manager, in addition to a CTA, to attend to day-to-day operational and management requirements of the project.

3. Site selection was critical in determining the project overall performance. The period of construction and commissioning including adhering to the local regulation and proximity to grid and supply stability of fuel sources should be considered fully during project design.

4. A formal M&E system linking project outputs to outcomes lodged in a computer-networking platform among participating institutions and agencies and supported with an active M&E policy, budget and organizational arrangements is very important in achieving the long-term national and global goals for which a UNDP-GEF project is always designed and approved to be implemented.