Final Evaluation of the UNDP-GEF Project: Removal of Barriers to Biomass Power Generation and Cogeneration in Thailand (THA: RBBPGC Project)

Evaluation Team

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EXECUTIVE SUMMARY

Background & Evaluation Approach

Mott MacDonald has been appointed to carry out the final evaluation for the UNDP/GEF Project "Removal of Barriers to Biomass Power Generation and Cogeneration in Thailand" (RBBPGC Project, the "Project"). This is the draft executive summary of the 'Final Evaluation Report' for the Project.

The Project is supported by the Global Environment Facility (GEF) and implemented through the United Nations Development Programme (UNDP) since June 2001 and due for completion in June 2009. The Project aims to reduce greenhouse gas emissions by accelerating the growth of biomass co-generation and power generation technologies to replace current fossil fuel consumption in Thailand. The sector-wide objectives against which the Project is evaluated comprise:

(a) build capacity to provide information and services to potential biomass power project investors;
(b) improve the regulatory framework to provide financial incentives to biomass power project investors;
(c) increase access to commercial financing for biomass power projects;
(d) facilitate the implementation of two initial [pilot] biomass power plants through support for commercial guarantees which will reduce technical risks associated with the deployment of new technology in Thailand.

The Energy for Environment Foundation (EFE), on behalf of EPPO, is the Project executing agency whilst the implementing unit is the Biomass Clearing House (BCH).

Final evaluation of the Project took place over the period April to May 2009 and is based on information gathered through document review, interviews, focus group discussions and pilot plant site visits. Documents received from EFE were used to identify key issues that relate to the processes, sustainability and success in achievement of project objectives. Interviews and focus group discussions were held to obtain perspectives from a representative range of knowledgeable parties, as detailed in the full report, to produce a fair and balanced final assessment.

Assessment by the Project's Objectives

EFE/BCH is seen by many stakeholders as having a significant influence on the growth of the renewable energy sector in Thailand. Activities and services carried out to achieve the Project's objectives during the eight year period mostly provide satisfactory levels of relevance, effectiveness and efficiency in achieving the four main objectives. The Project's contributions towards information resources and regulatory developments in support of renewable energy in particular are seen by several stakeholders as "outstanding" in their positive contribution to the sector.

A shortcoming of the Project has been in financial risk mitigation for biomass power plants, both in contributing to the capacity of financial institutions and in supporting the two pilot plants with a 'risk guarantee facility'. Analysis of causal linkages shows that the original Project design ceased to apply but could not be adequately adapted, when in 2003 the Industrial Finance Corporation of Thailand (IFCT) was merged with a commercial bank and could no longer play its foreseen role under the Project.

Lessons Learned

Central to the purpose of this Final Evaluation report is highlighting lessons learned for the future promotion of renewable energy (RE) sources in Thailand and lessons learned for the application of the Project's experiences in other countries, summarized as follows:

- Personnel changes and shortcomings in recruitment are widely agreed to have impeded Project implementation. More effective staff recruitment, development and retention could have further improved Project performance.
- The career uncertainty associated with the short-term funding cycle was identified as a significant constraint in recruitment, which could have been better managed through improved clarity on the intended model for long-term self-sustainability of the Project. Need for upfront clarity in seeking financial self-sustainability is required to help avoid the conflicts experienced by the Project over the extent of fee-based work carried out, and to provide a clearer long-term vision of financial stability.
- There is a need for improved flexibility in project design in order to effectively adapt to a rapidly changing context. Projects that are specifically designed to establish a collaborative partnership between public institutions and private sector entities, in a potentially fast-changing sector, should anticipate the need for project adaptation, including changes in a project's scope and objectives, incorporation of new institutional entities and revisions in financial requirements.
- An example of where the Project demonstrated flexibility is in extending its focus from biomass alone to a broader set of RE technologies, to better meet the changing market context. This trend could have usefully been further extended earlier in the Project, for instance to cover waste-to-energy.
- More detailed upfront research in Project design could have provided more accurate information regarding the biomass resources available in-country and level of biomass plant deployment at the time which could have enabled a more targeted assessment of specific barriers to be tackled within the scope of the four main objectives, and potentially more cost-efficient approaches to tackling such barriers.
- Major success indicators for any large scale power plant include a low level of environmental impact and plant acceptance by the community. Public opposition is still a major risk, and any (biomass) power plant needs to build community support at the planning stage of new developments. Lack of consistent enforcement of environmental standards is seen as a barrier to power plant acceptance by local communities, whether the plant fuel uses fossil or renewable fuels. A consistent focus on local environmental impacts and benefits is required to mitigate opposition to power plant development.
- Two pilot plants were supported by the Project through total contributions of US$ 3 million towards the fees for risk guarantee facilities. The risk guarantee facility model does not appear to have been effectively demonstrated by the pilot plants, however, and constraints related to the biomass market structure in Thailand mean that it is unlikely that a similar commercially-provided facility would be a competitively priced means of fuel price risk mitigation, compared with fuel supply management by the plant. On the basis of evidence available, the

subsidized guarantee facility seems a poor approach to support the growth of the RE sector in Thailand or similar market environments.

- Information and regulatory support is more significant than financial support for barrier removal at the current general stage in RE sector maturity in Thailand. A majority of stakeholders considered that the most valuable contributions the Project has made are supply of information to potential developers, including technical and non-technical advice; and contributing towards the current financial and non-financial regulatory support mechanisms for renewable energy projects in Thailand.
- Technical barriers to biomass and biogas power plant development are no longer seen as significant, provided plant owners use credible equipment suppliers. Outstanding barriers to RE plant development in Thailand include up-to-date information on available natural resources; predictable regulation of RE policies and sector support programmes; and weak relations between developers and the community. The Project provides a good case study in effectively sustaining its achievements through ongoing programmes at EFE, including further work to remove these outstanding barriers.

Operational Recommendations

In general, stakeholders saw the Project as successful, in particular given significant changes in the Project context and staff resource limitations. Of particular note is that several progressive governmental regulations supporting RE, adopted since 2006, are based on policy studies and advocacy carried out by EFE under the Project.

Based on the operational model provided by EFE a key recommendation is that an executing agency for similar projects should provide:

- Strong links with a range of branches of government and academia.
- A stable long-term platform for the Project and complementary activities, both before and after the Project term.
- Strong technical skills for effective engagement with the private sector on project development.

Limited strategic guidance was provided by the Project Steering Committee (PSC), particularly late in the Project. Such limitations were compensated for by a more active oversight role taken by the EFE board. A number of PSC members had little exchange with BCH and felt that they were only ‘contributors’, not ‘stakeholders’ of the Project. To improve the involvement of PSC bodies for future projects, committee members should ideally have closer familiarity with the project activities, through more regular meetings with accessible briefing materials.

A lack of staff resources has been the major constraint on the Project performing even better than it has. Staffing constraints could likely have been reduced through either better Project design or through a more vigilant, sustained joint effort by UNDP and EFE to adapt the Project focus gradually to new sector demands.

TABLE OF CONTENTS

List of Abbreviations

APR	Annual Progress Report
ASEAN	Association of Southeast Asian Nations
BAY	Bank of Ayudhya / Krungsri
BCH	Biomass Clearing House, implementing unit for the Project
BFB	Bubbling Fluidized Bed, type of biomass-fired boiler
BOI	Board of Investment (Thailand)
BOSCH	Biomass One-Stop Clearing House, former name for BCH
BRS	Biomass Resource Study
CDM	Clean Development Mechanism, a flexible carbon trading framework
CDR	Combined Delivery Report, financial reporting to UNDP
CER	Certified Emissions Reduction, carbon credits issued to CDM projects
CFB	Circulating Fluidized Bed, type of biomass-fired boiler
CO_2	Carbon Dioxide
CTA	Chief Technical Advisor
DANIDA	Danish International Development Assistance
DEDE	Department of Alternative Energy Development and Efficiency
EFE	Energy for Environment Foundation, executing agency for the Project
EGAT	Electricity Generating Authority of Thailand, state power utility
EnCon Fund	Energy Conservation Promotion Fund
EPPO	Energy Policy and Planning Office
ESCO	Energy Service Company
FI	Financial institution
FPPS	Foundation for the Promotion of Public Policy Studies
FTI	Federation of Thai Industry
GEC	Gulf Electric Company
GEF	Global Environment Facility
GEM	Green Energy Mechanism
GHG	Greenhouse Gas
GOT	Government of Thailand
GYG	Gulf Yala Green, pilot plant
IFCT	Industrial Finance Corporation of Thailand
IPP	Independent Power Producer
IRR	Internal Rate of Return, metric for an investment's financial performance
JBIC	Japan Bank for International Cooperation
kW	Kilowatt, unit of electrical power
LTE	Long-term Expert, as co-financed by DANIDA
M&E	Monitoring and Evaluation
MW	Megawatt, unit of electrical power
NGO	Non Government Organisation
NPD	National Project Director, of RBBPGC Project
NPM	National Project Manager, of RBBPGC Project
PD	Project Document
PIR	Project Implementation Report, regular progress reporting to UNDP
PMO	Project Management Office
PR	Public Relations
PSC	Project Steering Committee
QA	Quality Assurance
QUANGO	Quasi Non-Governmental Organization
RBBPGC	Removal of Barriers to Biomass Power Generation and Cogeneration in Thailand, the Project under evaluation
RE	Renewable Energy
REG	Roi-Et Green, pilot plant
REIC	Renewable Energy Information Centre, at DANIDA

SME	Small and Medium Enterprise Development Bank
SPP	Small Power Producer, on-grid plant selling between 10 and 90 MW
STE	Short-term Expert, as co-financed by DANIDA
TMB	Thai Military Bank
TOR	Terms of Reference, for this final evaluation
UNDP	United National Development Programme
VSPP	Very Small Power Producer, on-grid plant selling less than 10 MW

1. INTRODUCTION

1.1 Project Background

The "Removal of Barriers to Biomass Power Generation and Cogeneration" project (RBBPGC, or the Project [1]) is a Global Environment Facility (GEF) supported full size project implemented through the United Nations Development Programme (UNDP). The Project aims to reduce GHG emissions by accelerating the growth of renewable power generation technologies to replace current fossil fuel consumption in Thailand, consistent with GEF Operational Programme No. 6, "Promoting the Adoption of Renewable Energy by Removing Biomass Development Barriers and Reducing Implementation Costs".

The Energy for Environment Foundation (EFE) is the Project executing agency, on behalf of the Energy Policy and Planning Office (EPPO), under the Ministry of Energy. The majority of the Project activities are implemented through the Biomass Clearing House (BCH), which provides information services, technical advice and financial consultation to potential developers, interested groups, government agencies and the general public. Separate from BCH, a policy cell within EFE also carries out studies to influence regulatory support for renewable energy.

The Project officially began on 20th June 2001 and at the end of 2004 a mid-term evaluation was carried out. The Project is due to complete on 19th June 2009, before which time this final evaluation has been carried out, to provide all parties concerned with a review of performance and lessons learned.

1.2 Purpose and Scope of the Evaluation

The final evaluation aims to review the performance of the Project towards achieving its target objective and outcomes, from 2001 to the present.

The review assesses and rates project results relative to the targeted objectives and outcomes with respect to their relevance, effectiveness and efficiency. The assessment of project results attempts to determine the extent to which the Project objectives were achieved, and seeks to compare the extent of achievement and shortcomings in reaching the Project's objectives to a baseline as initially stated in the Project Document.

Lessons learned and best practices are identified, in particular to provide recommendations for the design and implementation of other UNDP/GEF projects. Further details on the terms of reference for this final evaluation are included in Annex 1. The final evaluation has been carried out over a two-month period, during April and May 2009.

The mid-term evaluation, begun in late 2004 and finalized by June 2005, covered the same basic scope, though with greater emphasis on operational recommendations and areas of potential to enhance the Project's ongoing performance.

[1] Consistent with the terminology used in the mid-term evaluation the RBBPGC Project is referred to as "the Project", while other renewable energy projects are referred to as "projects" or plants.

One challenge faced by this evaluation has been limited personal and institutional recall of early stages in the Project, due to a combination of the long, eight-year Project span and a high related turnover in the broad set of Project participants since the Project first began. As a primary source of information and analysis on the Project up to 2005, this final evaluation has relied primarily on the thorough and insightful mid-term evaluation report, to which we also refer any reader specifically interested in the early period of the Project.

1.3 Evaluation Methodology

1.3.1 Evaluation Context

To put this final evaluation in the proper context, it should be noted that the Project mid-term evaluation, completed by the Foundation for the Promotion of Public Policy Studies (FPPS) in June 2005, and published on the GEF website, included significant recommendations to refocus the Project due to a rapidly evolving renewable energy industry in Thailand. In particular, the mid-term evaluation noted that:

- At the time of the mid-term evaluation (2005) there already had been widespread success in the uptake of large-scale biomass in Thailand, particularly by agro-industry. As a result there was limited biomass supply available for new plants, greatly decreasing the opportunity to support large-scale biomass and instead leading to greater opportunities for additional small-scale projects in each of biogas, biomass and other renewable energy generation technologies.

- As a consequence of the changing market context, the institutional roles of EFE and BOSCH were adjusted significantly with respect to policy studies and advocacy, on the one hand, and commercially-oriented renewable energy project development support service on the other. As a result, from 2006 onwards the Project was to give much greater focus to policy studies and advocacy, not only for biomass projects but for other renewable energy technologies for power generation as well, including wind and solar power.

This final evaluation will seek to validate the ongoing relevance of Project activities within the context of this rapidly changing development context. The evaluation builds upon the successes of the Project as outlined in the mid-term evaluation and the subsequent decisions regarding the refocusing of RBBPGC undertaken by Project stakeholders.

1.3.2 Data Collection

Data collection for the evaluation consisted of four integrated steps: (i) desk review of relevant documents and reports related to the Project; (ii) focus group discussions and structured interviews with key stakeholders; (iii) project field visits; and, lastly (iv) feedback both among the evaluation team, and between the evaluation team and key stakeholders to ensure full coverage, to interpret key findings, and to confirm conclusions during the write-up. Each of these steps is briefly described below.

1.3.3 Review of Relevant Documents

Documentation reviewed for the evaluation included among other sources the following:

- Core documents including the Project Document (Project No. THA/99/G31/A/1G/99) and other project redesign and adjustments following the mid-term evaluation by FPPS;
- Previous quarterly (to UNDP), biannual (to EnCon Fund) and annual (to UNDP/ GEF) progress reports. Key among these include yearly UNDP GEF Annual Progress Reports (APRs) and Project Implementation Reports (PIRs);
- Reports from each of the Project Steering Committee meetings
- Project documentation and reports on the biomass pilot projects facilitated by the RBBPGC Project, Roi Et Green and Gulf Yala Green;
- Current project organization charts, including key staff (including changes over the life of the project), external stakeholders and beneficiaries; and
- The finalized mid-term evaluation report, of June 2005
- Reports on other activities and specific deliverables.

Documentary review focused on identifying key issues that relate to the processes, sustainability and success in achievement of project objectives. Data from these reviews were further explored and verified during subsequent structured interviews and focus group discussions.

1.3.4 Focus Group Discussions and Interviews with Key Stakeholders and Beneficiaries

The major source for assessment of the Project's success and failures were the remembered experiences and insights from current and prior Project implementing staff, supervisory personnel, national officers and representatives from responsible ministries and supporting agencies, pilot project developers, and other stakeholders, including project beneficiaries. A list of personnel that participated in the focus group discussions and interviews are shown in Annex 2: List of Interviewees.

Several factors limited the longitudinal scope of the insights with respect to Project implementation. Particularly challenging was the almost complete turnover in staff and stakeholders over the full eight years of the Project life. This was particularly notable since after the mid-term the Project entered into what is termed "the second phase". During this phase the Project shifted from supporting biomass generation with identifiable stakeholders and beneficiaries, to greater emphasis on advocacy and making technical support available for a range of renewable power generation alternatives to a widespread audience of potential beneficiaries. While such policy advocacy is reportedly useful, these assessments are based on qualitative interpretations.

As a consequence, limited interviews were directly carried out with beneficiaries, with such beneficiaries included in the survey limited to the pilot projects and institutional stakeholders. This decision was taken since the majority of other beneficiaries are diffuse – having limited and/or only casual contact with BCH (e.g. website users), and insufficient knowledge of the Project to distinguish the GEF-funded works from EFE's more general activities. Whilst interviewing such 'casual' or 'uninformed' beneficiaries might assist in making operational recommendations, it is of limited value for assessing broad achievement of the project objectives.

1.3.5 Project Field Visits

Site visits were conducted at two biomass pilot projects:

1) Gulf Yala Green Power Plant—a 23 MW biomass power plant using waste rubber wood as fuel which is located in Lum Mai sub-district, 15 km west of Maung District, Yala Province (about 1000 Km south of Bangkok); and
2) Roi-Et Green Power Plant—a 9.8 MW biomass power plant which uses rice husk as fuel. The power plant is located on the Roi-Et-Kalasin road 10 km from Muang District of Roi-Et (about 500 km northeast of Bangkok).

Detailed reports of the two site visits are found in Annex 7: Demonstration Value of the Pilot Plants. The site visits focused on the operational history, technical project development and operation, financial risk management, shareholder structure, community engagement and environmental impacts. The most significant aspect of the assessment was review of the impact of the pilot projects as a source of leverage and demonstration to promote new biomass technologies.

1.4 Assessment of Project Results

In assessing the level of achievement of the project's objectives and outcomes, the following three criteria are examined with respect to each outcome:

- **Relevance**: Were the outcomes consistent with the designed operational program strategies and country priorities?
- **Effectiveness**: Are the project outcomes commensurate with the original or modified project objectives?
- **Efficiency**: Was the project cost effective? Was the project the least cost option? Was the project implementation delayed, and if so, how did this effect cost effectiveness?

Both quantitative indicators and qualitative data are used to rate the Project's objectives and outcomes on a six-level scale ranging from Highly Satisfactory (HS), through Satisfactory (S), Marginally Satisfactory (MS), Marginally Unsatisfactory (MU), Unsatisfactory (U), to Highly Unsatisfactory (HU). The rated performance of the Project in terms of management and implementation is central to the evaluation of the four main Project objectives:

(a) **Capacity Building**—as measured by the Project's capacity to provide information and services to potential biomass power project investors. As noted, this objective was modified to expand the role of information and RE policies proposed and the advocacy role of BCH;
(b) **Improved Regulatory Framework—**as measured by the success of the regulatory steps taken to provide financial incentives and other support to biomass power project investors;
(c) **Access to Commercial Finance—**as measured by the Project's success in providing increased access to commercial finance for biomass co-generation and power projects; and

(d) **Deployment of New Biomass Technologies**—as measured by relative success in the implementation of two initial biomass power plants through commercial risk guarantees.

Since the Project's mid-term evaluation each of these main Project objectives have been modified and adapted to the emergence of a new, more dynamic renewable energy industry in Thailand. How these objectives have adapted, and the relative success of these changes are major components of this final evaluation.

The final evaluation's conclusions are found in the final two sections of the report on Lessons Learned (Section 6) and Operational Recommendations for Future Projects (Section 7). The conclusions build upon the above ratings, the interviews and focus group surveys and the documentation review, in addition to consideration of the following four underlying themes:

1) **Sustainability of Project Outcomes**—including measures of the likelihood of continued benefits after the UNDP/GEF Project ends;
2) **Catalytic Role**—the extent to which other project level activities are undertaken or should be undertaken to replicate the Project;
3) **The M&E System**—including evaluation of the achievement and shortcomings of the Project M&E plan and of implementation of the M&E plan; and
4) **Processes that Affected Attainment of Project Results**—including a range of factors that impact implementation such as the following:
   - Clarity and practicality of Project objectives *vis-à-vis* the intended roles and available capacities plus resources of the executing institution and counterparts;
   - Involvement and commitment of the Thai government in the Project *vis-à-vis* the degree of correspondence between the Project concept/aims with national development priorities/plans;
   - Making best use of available skills and involvement of relevant parties as stakeholders in all stages of the Project, where necessary through outreach and public awareness campaigns;
   - Adequacy of controls and reporting of Project financial status for effective financial management and planning;
   - Level of co-financing achieved (to be reported as per the Table in TOR Annex 1) relative to project expectations, explanations for the variance, and causal explanation for the affect on outcomes and impacts of any variance;
   - Effectiveness of the supervision provided by UNDP and EFE to BCH both through routine interactions as well as timely and appropriate response to the need for Project changes; and
   - Basis for any schedule delays and causal explanation for any effect on Project outcomes and/or sustainability.

The aim of the evaluation is not just to measure what has happened over the duration of the Project, but more importantly to seek direction and lessons learned to guide future investments. The evaluation seeks to highlight factors that have contributed to sustainable achievement of project objectives, and to make recommendations on how these lessons can be applied to other similar GEF projects in the future.

1.5 Evaluation Team

The Mott MacDonald evaluation team comprised the following members, including renewable energy sector and project evaluation specialists:

Mr. Gene M. Owens	Project Director / Evaluation Advisor
Mr. Philip Napier-Moore	Project Manager / Team Leader
Mr. Surasak Phanraungwong	
Mr. Piya Lertpiyayowong	
Ms. Usa Nitmetawong	
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Further detail on the scope of the evaluation is provided in Annex 1: Final Evaluation of the UNDP/GEF Project: Removal of Barriers to Biomass Power Generation and Cogeneration in Thailand—Terms of Reference.

1.5.1 Communication of the Evaluation Results

The evaluation report has been submitted in preliminary draft form on 27th May 2009 and reissued in final draft form, responding to initial comments, on 5th June 2009.

The evaluation report will be presented at the Project Steering Committee meetings of 15th June 2009 and subsequently issued in final form on 19th June 2009, taking account of further inputs.

2. Scope and Objectives of the Project

2.1 Scope of the Project

In 1999-2000, when the RBBPCG Project was under design, electric power generation in Thailand was dominated by fossil fuels, with gas, oil and coal accounting for more than 80% of total electricity supply. In spite of a substantial unexploited biomass resource potential—principally from bagasse, rice husk, palm oil waste and wood residues—the development of renewable energy for power in Thailand had mainly been on a research and pilot demonstration scale. A major objective of the RBBPCG Project was to move beyond research to practical applications of the use of biomass for renewable energy, and further toward development of private biomass business models for power generation at local levels.

In order to accomplish this objective, several critical barriers to biomass power generation and co-generation had to be removed. Key barriers that were seen as critical hindrances included:

- Lack of information and services provided to the potential biomass power and co-generation power developers. As expressed in the Project Appraisal Report, "there is no 'one-stop-shop' in Thailand where potential power project developers can obtain sufficient information as well as competent advisor services in matters related to technology, legal issues, preparation of agreements/contracts, financing, and etc.";
- Limited regulatory framework to encourage biomass power projects;
- Lack of appropriate financing mechanisms to support biomass co-generation/power projects;
- Uncertainties and difficulties of biomass fuel supply; and
- Lack of successful models to demonstrate large-scale and efficient biomass co-generation/power systems and project development models.

A primary institutional tool to address these barriers to the adoption of renewable energy was the introduction of a Biomass One-Stop Clearing House (BOSCH), later renamed the Biomass Clearing House (BCH). During implementation the BCH went beyond the removal barriers to in actual fact providing support services for deployment of a range of RE technologies.

The principal national development objective of the RBBPCG Project is related to global climate change. As stated in the Project Document, the development objective is:

> "The reduction of the potential adverse social, environmental and economic consequences of global climate change caused by GHG from combustion of fossil fuels through removal of the major barriers to the development of biomass co-generation and power generation in Thailand." [2]

As described in the Project Document, the Project aims to reduce GHG emissions by accelerating the growth of biomass co-generation and power generation technologies to

[2] UNDP/GEF, Project Document, Removal of Barriers to Biomass Power Generation and Co-Generation in Thailand, Project Number THA/99/G31/A/1G/99, Bangkok, 20 June 2001.

replace current fossil fuel consumption in Thailand. The objectives against which the Project is evaluated comprise:

(a) build capacity to provide information and services to potential biomass power project investors;
(b) improve the regulatory framework to provide financial incentives to biomass power project investors;
(c) increase access to commercial financing for biomass power projects;
(d) facilitate the implementation of two initial biomass power plants through support for commercial guarantees which will reduce technical risks associated with the deployment of new technology in Thailand.

As designed, the Project objectives were to be achieved over a duration of seven years from June 2001 to June 2008. A revised closing date of 19th June 2009 was subsequently renegotiated to allow the Project to complete substantive inputs with no budget increase. These specific project objectives as stated under items a) through d) comprise the principal focus of this final evaluation report.

2.2 Work Plan

The Project has generally succeeded in fulfilling the work plan, and has exceeded reasonable work plan expectations with respect to several areas of activity (see Annex 4). The Project has also suffered from persistent difficulties in recruiting skilled staff and in changes to the market and institutional context that affected implementation of the work plan. The Project has overall performed impressively, in particular given staffing and other constraints, however there have still been delays and resource gaps that affected implementation of the work plan.

While a detailed work plan was presented in the original Project Document, highlighting immediate objectives, outputs, work duration and expected dates of completion, early Project Implementation Reports (PIRs) show that there was considerable initial slippage due largely to the slow pace in establishing and staffing the organizational structure for implementation. As documented in the mid-term evaluation, the Project faced early delays due to the challenge of recruiting well-qualified staff and to institutional changes. As initially designed, it was expected that the Project would be under the management of what is now the Energy Policy and Planning Office (EPPO), with a small policy-focused staff. Shortly after operations commenced in 2001, the Energy for Environment Foundation (EFE) was restructured to assume project responsibility, including the recruitment of staff, establishing the working relationships between the EFE, the newly established Biomass One Stop Clearing House (BOSCH) and the Project Steering Committee (PSC), setting up a financial and accounting system, and the procurement of office and equipment.

Given the early difficulties in institutional adaptation and set up, the reporting system[3] shows that the RBBPGC Project generally progressed as planned to the satisfaction of all

[3] The reporting system comprises three key elements: (a) the annual Project Implementation Review to the GEF, (b) bi-annual report to the Energy Conservation Promotion Fund (EnCon Fund), and quarterly reports to UNDP. Biannual progress reports to the DANIDA and EnCon Fund were also submitted up until 2006 and 2007 respectively, when such funding ceased.

parties is an extraordinary achievement given the complexity of the project and the difficulties that the project experienced during 'start-up'.

The Project can usefully be divided into two distinct periods of activity – from 2002-2005 (the 'first phase') and 2006-2009 (the 'second phase'). During the first phase – in particular in 2004 and 2005 – the Project's main focus was on fee-based services, providing technical support to RE plant developers. During early 2006, the Project underwent a refocusing due primarily to concerns that such fee-based services were diverting efforts from the Project's public-interest activities, with which they were to some extent incompatible due to the need for greater independence from the private sector, and could also undermine the emerging private sector RE consultancies in Thailand. These issues are highlighted in the mid-term evaluation, the BCH business plan of 2004 and the PSC meeting records, with the Project adapted accordingly in April 2006.

As a consequence, within the scope of the four main objectives, the Project refocused its implementation practices so as to (1) emphasize work in the common, public interest rather than fee-based work, assisting specific developers; and (2) formally broadened the Project's focus from biomass only to cover all renewables, in particular small scale RE power generation.

BCH had in any case already expanded its activities to include not just biomass but advisory services for other renewable energy sources including biogas, wind and solar – due to greater demand for support in these areas with the changing market context. While technologies other than biomass were outside the originally envisaged project scope, it is reasonable to conclude that the expanded focus to all RE technologies was a necessary adaptation by the Project to changing circumstances (see section below) – and remains in line with the development of renewable and clean energy in Thailand – the overall national objective.

Less than a year after the completion of the Mid-term Review, finalized in June 2005, the Project faced a significant reduction in staff and resources, particularly during 2006 – a period that one UNDP Country Officer termed "the vacuum period". In particular, the majority of technical staff left BCH, due to the shift in emphasis away from fee-based technical activities. While consistent with the refocusing, this did leave a capacity gap.

In the second phase there have been fewer staff, fewer outputs, and fewer PSC meetings. Nevertheless, the Project has achieved a number of significant outcomes, notably in the areas of information dissemination, policy, and in establishing ongoing, relevant RE sector programmes for the post-Project period. Such future programmes were made possible because of the Project, and continue the pursuit of the Project objectives. The future programmes' activities therefore help provide sustainability both in the achievement of the Project objectives and in securing ongoing funding for 'financial self-sustainability'.

It could reasonably be concluded that the work plan in the second phase has better focused available resources on achievement of the Project objectives, in niche areas where BCH support is most required by the RE sector. It should also be noted, however, that staff shortages also prevented follow-up with all enquiries and led to consistent under-spend against quarterly activity budgets – since resources could not always be

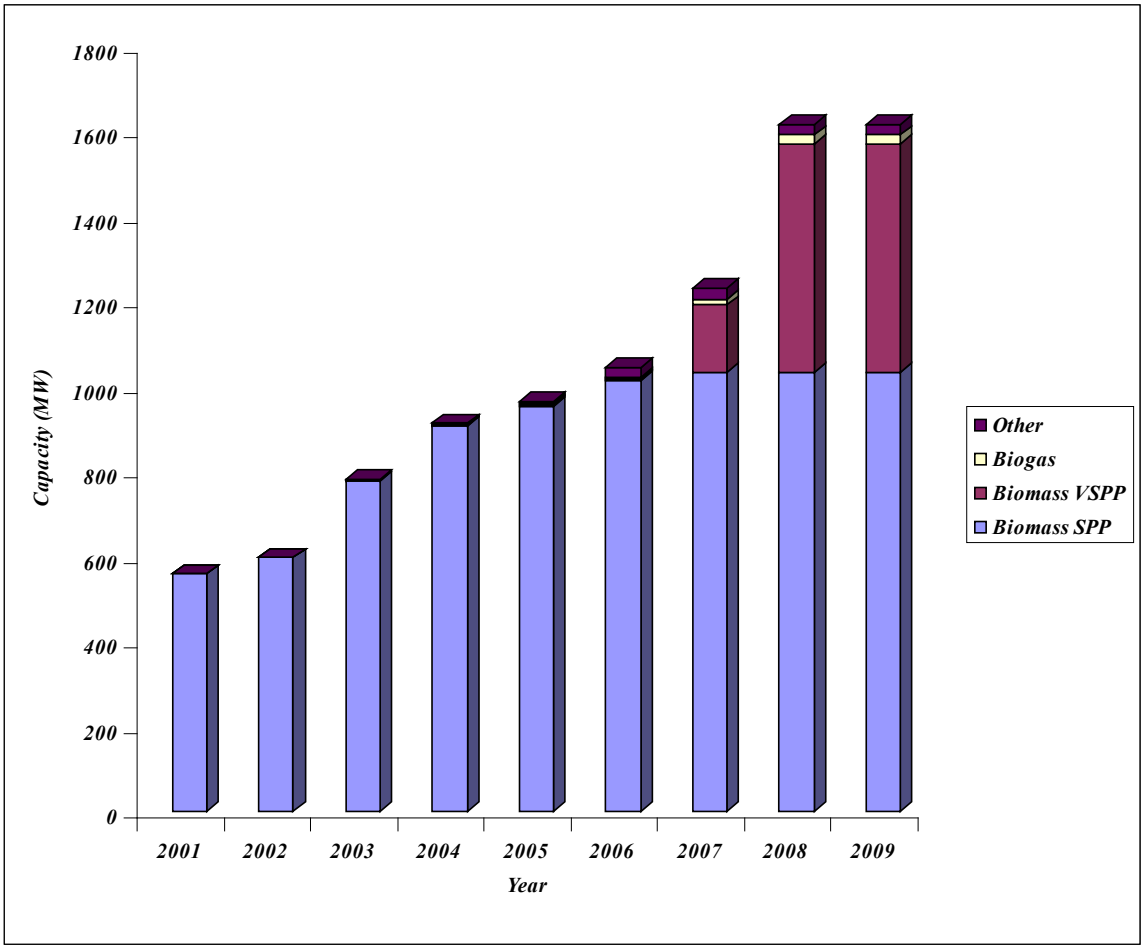
mobilized to meet the quarterly work plan. Outsourcing to independent consultants was used where possible, for specific assignments (e.g. policy studies, training seminars), to mitigate against staff shortages.

Generally positive and satisfactory progress in achieving project objectives has been reported yearly in PIRs up to 30th June 2008. In recognition of its expanded scope and continued success, the Project received approval for a one year extension from UNDP on 30th October 2008. Such extension was possible without an increase in the total Project budget, due to previous under-spending relative to the work plan. The Project is now due to terminate on 19th June 2009.

2.3 Project Context & Adaptation

From a relatively constant base of low-efficiency biomass boilers, mainly at sugar mills, throughout the 1990s, the RE sector has experienced rapid growth for the past decade, as shown in Figure 1 below. RE growth was first stimulated by the introduction in 2001 of a power purchasing price "adder" for RE based on competitive tender, with an average concessional premium of 0.18 Thai Baht per unit to the standard wholesale power tariff awarded to 14 projects.

Figure 1: Renewable Energy Installed Capacity in 2001 – 2008, SPP & VSPP



In October 2006, the Ministry of Energy introduced an improved revision to the 'adder' tariffs, with set adder levels varying by RE plant type. This regulatory support measure, adopted partly based on BCH policy cell recommendations, can already be seen to have

provided a further boost to the sector – particularly for VSPPs with comparatively low project development periods. VSPPs were further boosted by another policy cell recommendation to raise the capacity threshold for power sold to the grid, from 1 MW to 10 MW.

This rapid growth and commercialization of the RE sector, in particular through biomass-fired generation, has led to a constant evolution in the demands on the Project from the private sector, and an ever-shifting optimal role for the Project, as discussed below.

Several implications for the project, both positive and negative, include:

- The Project both contributed to, and benefitted from, a widespread increase in interest both for biomass plant in particular and renewable energy in general. The effectiveness of Project efforts to influence government policy are seen to have benefitted from this responsive climate.
- The Project Document's initial focus on biomass in 2001, including in particular biomass in the 10-20 MW range through the selection of the pilot projects, was somewhat "overtaken by events" since the viability of biomass generation and co-generation at this scale in Thailand significantly reduced with rising biomass feedstock prices, early in the Project life-span.
- Both as a result of the above and of continuing rapid uptake of biomass at a smaller scale, among other sector developments, the Project therefore faced a significant challenge of continually adapting to the most relevant new needs for public support in a rapidly evolving context.

This rapid take-up of biomass technology using new feedstocks was widely unexpected, and also came as a surprise to the 'early-mover' developers and investors who now face much higher fuel prices than anticipated when their plants were first proposed, when there was not such competition for biomass feedstock.

It can also be argued that the Project was a "victim of its own success" in promoting renewables. Early success in encouraging biomass plant deployment above 5 MW meant that the Project had little further role as a "one stop service" for such plants. Significant barriers were swiftly removed and the technology mainstreamed by the agro-industrial companies that control the biomass residues. Instead the Project had to adjust its focus to smaller-scale biomass and other RE technologies – requiring new skills and approaches.

An almost universal theme raised by funders, other stakeholders and senior level EFE/BCH staff interviewed was the flexibility of the Project – with each respondent seeing barriers to constructive adaptation of the Project to reflect changing circumstances and ongoing findings. Different respondents identified the major barrier either as limited proactive generation of new proposals to the donor by the executing agency, or limited donor flexibility to change how funds are allocated given initial exploration of proposals to adapt to changing circumstances.

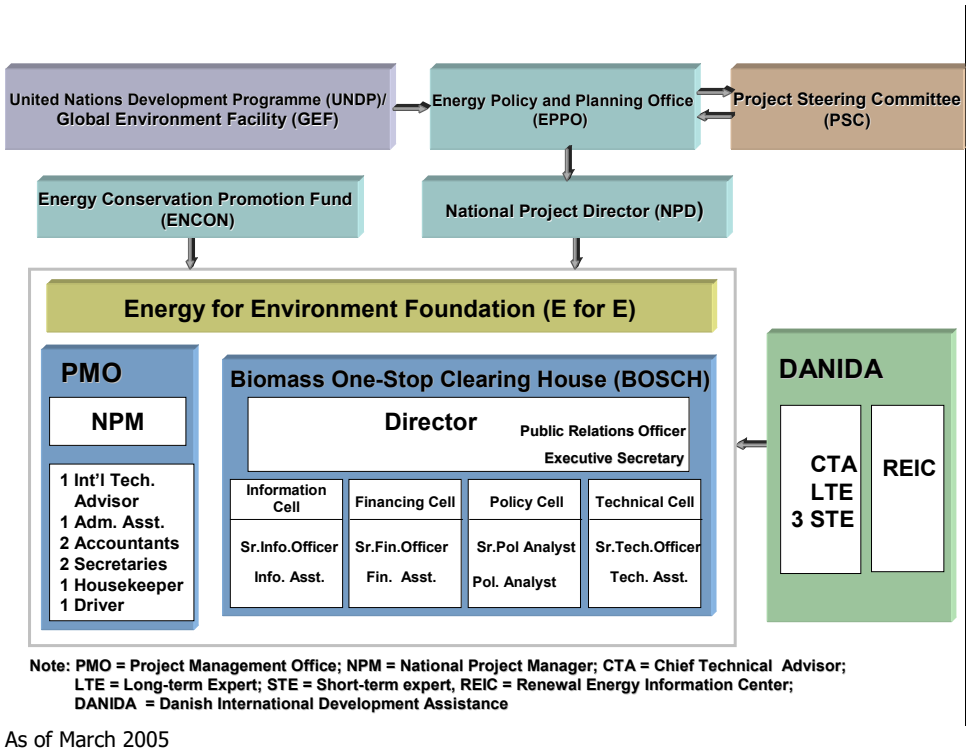
One key PSC member believed the Project should have been shorter, despite the operational complications this would raise, so that the objectives could be revisited more frequently in light of changing circumstances. The issue of Project flexibility is further discussed in Sections 6.1 and 7.3.

3. Institutional Arrangements for Project Implementation

3.1 Organizational Structure

The basic organizational structure during the majority of the Project period remained the same, except for the lack of staff to occupy some positions. This structure is shown in Figure 2 below, based on that presented in the mid-term evaluation.

Figure 2: The Basic Organizational Structure during the Majority of the Project Period



Note: PMO = Project Management Office; NPM = National Project Manager; CTA = Chief Technical Advisor; LTE = Long-term Expert; STE = Short-term expert, REIC = Renewal Energy Information Center; DANIDA = Danish International Development Assistance

As of March 2005

The exception to the continuity of the above organizational structure is the removal of the policy cell from BCH in mid 2005, as shown in Figures 3 and 4 below.

The organizational structure going forward has been revised as of early 2009 to better integrate BCH's functions into ongoing EFE activities, including fewer layers of management. The current situation is as shown in Figure 5 below.

Figure 3: The Organizational Structure after Removal of the Policy Cell in 2005, Chart 1 (staffing)

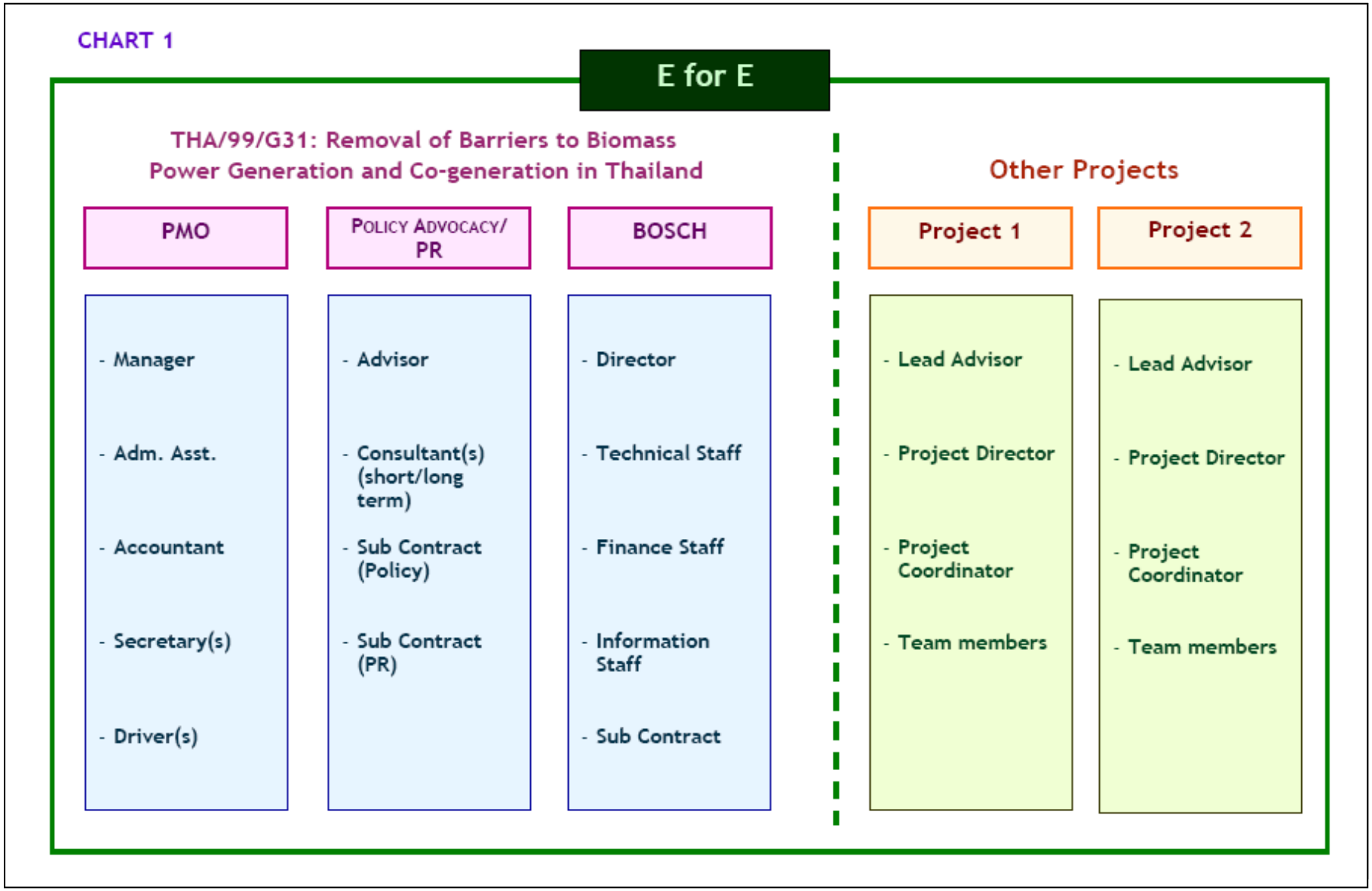
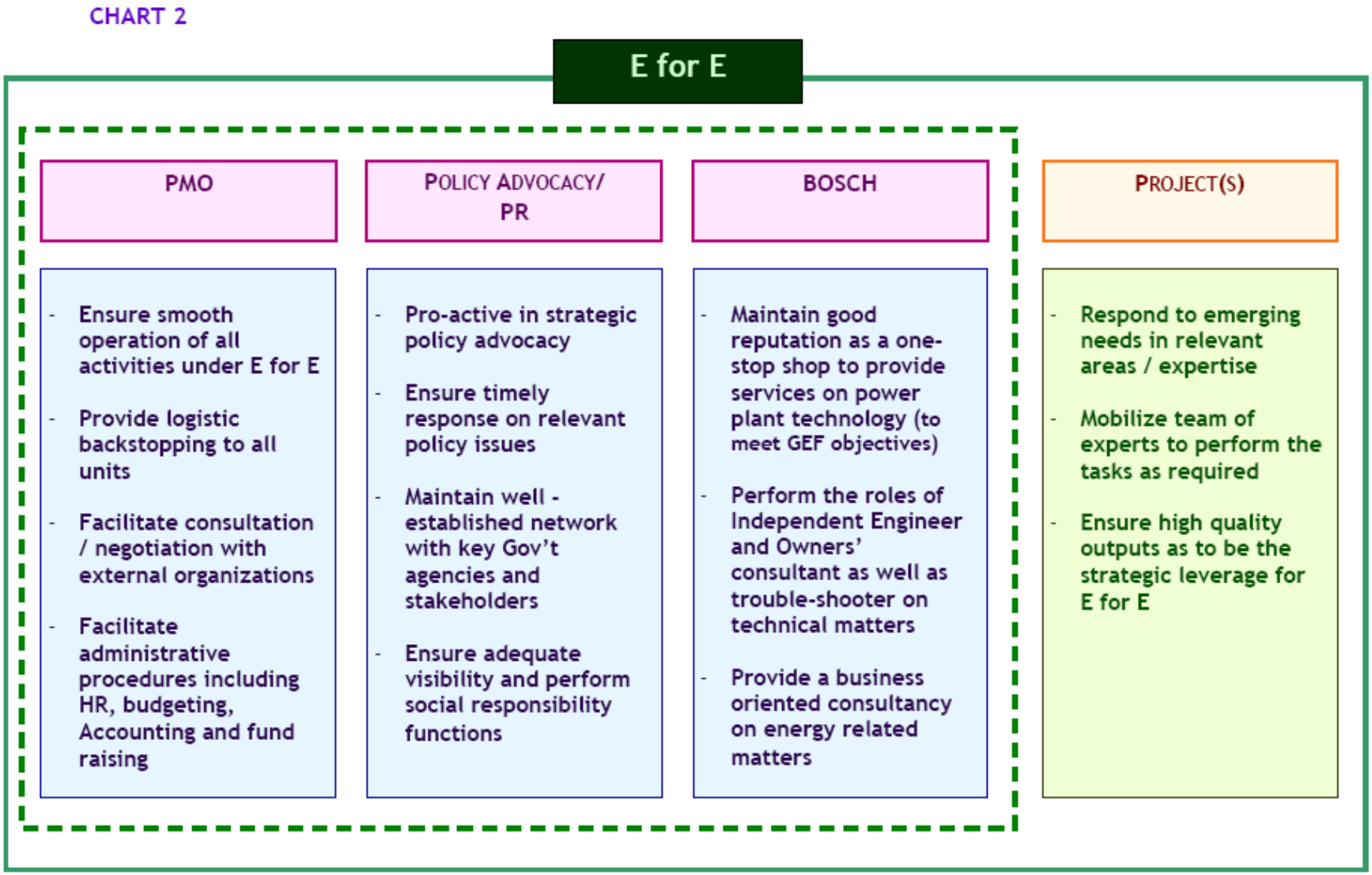
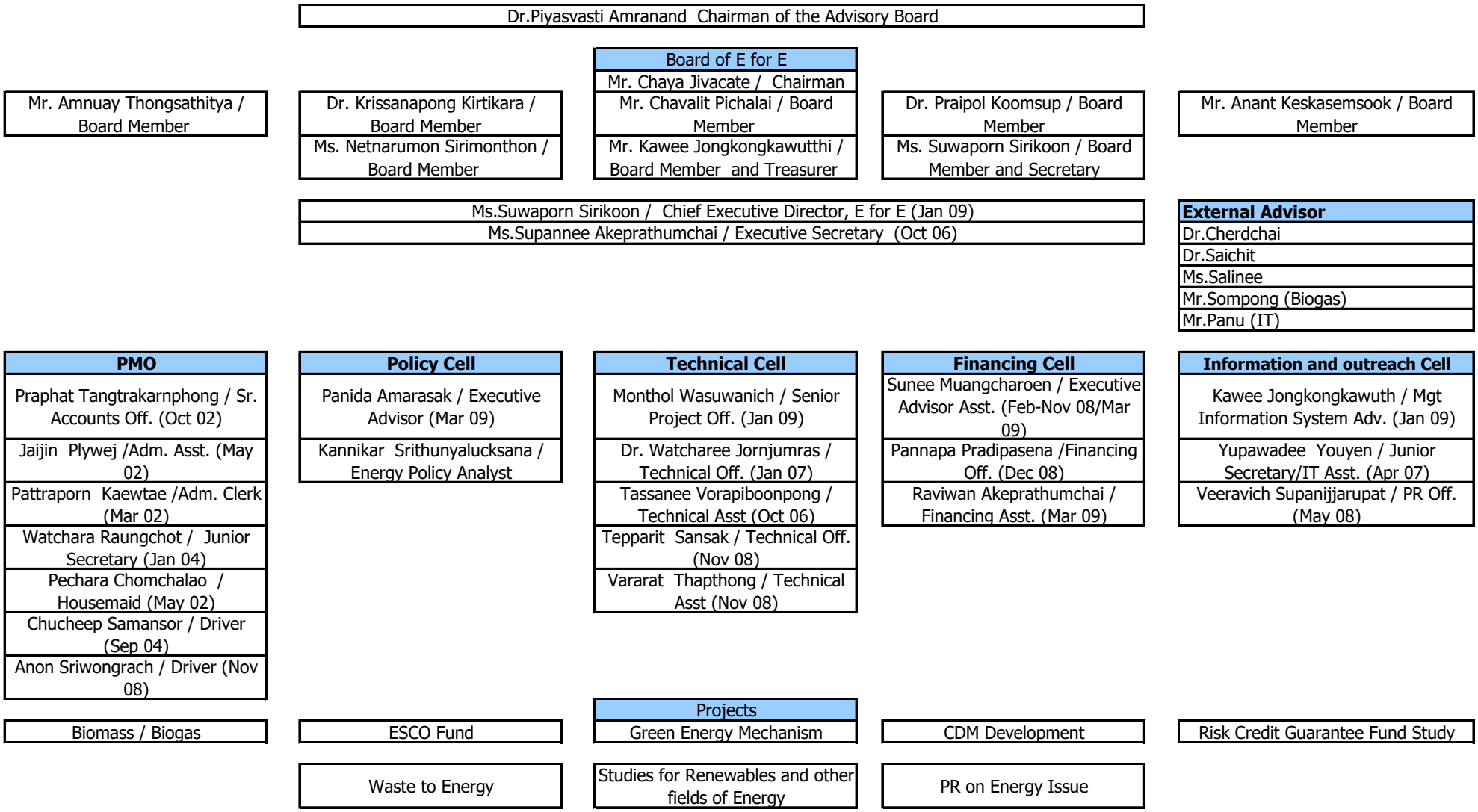


Figure 4: The Organizational Structure after Removal of the Policy Cell in 2005, Chart 2 (cell roles)



As of June 2005

Figure 5: The Present Organizational Structure – Revised in 2009



As of April 2009

3.2 Project Oversight

The Project oversight system remained the same throughout the eight-year Project term, as already described in the mid-term evaluation.

There are three levels of Project oversight. Firstly, the 8-member EFE board that meets approximately six times a year. Secondly, the 14-member PSC, consisting of direct and indirect stakeholders and independent experts, convenes either once or twice a year. Thirdly, both the National Project Director and EFE advisory board chairman separately reviewed the Project with the National Project Manager almost every month.

The PSC convened twice a year up to 2005 for an annual implementation review at mid-year and a review of the future annual work plan and budget at year end. Thereafter PSC meetings appear to have taken place only once a year, at mid-year for the annual implementation review, with the work plan instead formally approved directly through the National Project Director and UNDP.

Active PSC participants throughout the Project were EPPO, UNDP and EFE. The contributions of others – including other government departments, FTI, academics and banks – varied depending on the individual representative attending.

The mid-term evaluation remarked that "Given the infrequent PSC meetings, the complexity of the Project, the rolling work plan, the various reporting formats, the substitutions and frequent changes among the ex-officio members – several PSC members have only limited knowledge of the progress of the project and little exchange with BOSCH, and feel that they are only 'contributors', not 'stakeholders' of the Project."

This remains an accurate description of the current status of the PSC at the end of the Project, and is perhaps even more true in 2009 than in 2005, since the long Project span combined with less frequent PSC meetings reinforced the above-identified trends. Also similar to during the first phase, some PSC members would have liked more substantive exchanges with BCH than allowed for within the operationally-focussed PSC meetings. Additional contact with the PSC members, representing themselves as individuals, occurred in several cases through expert group meetings, held 3-4 times a year, which did provide an alternative venue for discussion of certain substantive issues, though without such scope to influence Project strategy.

As noted above, PSC attendees were not in general consistent throughout the span of the Project, either with changes in the designated attendee (e.g. due to promotions, resignations etc) or delegation of attendance to the designated attendee's staff. One factor in such lack of consistent attendance appears to have been that some designated attendees did not feel sufficiently 'invested' in the Project as only 'contributors', particularly in the second phase. One PSC member believed that more regular updates on progress from the Project and more sense that the contributions made to the PSC meetings would impact on the work plan would have improved how invested he felt in the Project and his frequency of attendance. As it stood, PSC meetings could apparently feel like a 'rubber-stamping exercise', without significant changes as a result of PSC discussions. Project management by contrast feel that useful critical input was received from at least the most active members of the PSC, and that the balance of skills represented was appropriate.

Such differing views in part simply reflect a natural tension between the relative influence on project strategy held by the executing agency and PSC members. Even so, it appears likely that for a project of such long duration that only indirectly impacts on most PSC members' regular work, that optimal input from PSC members may require a different approach towards committee design – perhaps in terms of meeting frequency, committee size, the regularity and content of briefing material provided, and the organisations represented.

The EFE board met approximately every 2 months for the full duration of the Project, to discuss EFE activities, of which the Project has been a major component. The EFE board were seen as key to finding a solution to the conundrum of financial self-sustainability for the Project, such as in shaping the GEM program, and were seen by some respondents as providing more meaningful oversight to the Project than the PSC.

By comparison with the PSC, the EFE board members were seen to have

- A more direct stake in the Project's success through their long-standing involvement with EFE – which was dedicating the majority of resources to the Project.
- Closer familiarity with BCH's activities, through more regular meetings.
- Better RE sector insight, more relevant resources and better networks at their disposal through their full-time professional roles in their respective organizations.

While EFE board meetings also had a procedural focus, it appears that the above factors nonetheless allowed the EFE board to effectively assist in strategy formulation and in progressing complex activities requiring interface with different branches of government.

Taking together close working relationships between the PMO and UNDP, the National Project Director at EPPO and the EFE board, the Project is considered to have had adequate oversight, though the degree of oversight through the specific formal channel of the PSC was lower than optimal. The above-identified factors that allowed the EFE board to work effectively in the Project's interests offer a lesson learned with respect to future design of PSC bodies for similar GEF-funded initiatives.

3.3 Personnel

Project-related personnel at EFE (including the PMO, policy cell and BCH) cycled from 12 staff in early 2002, through a peak of 23 in 2004, down to around 14 staff in 2007. Following recent recruitment for the ESCO and GEM programmes (see Section 4: Assessment of Sustainability), 22 staff are now employed by EFE.

For the BCH specifically (excluding the PMO and from mid-2005 the policy cell), the workforce reduced from a peak of around 12 staff in 2004 to 7 staff in late 2007, with all staff members except the executive secretary having changed over this period. In particular, significant numbers of technical staff left BCH after the Project refocusing in early 2006.

Project management is generally seen by stakeholders as strong, and a significant mitigation against the risks associated with staff turnover, of losing both skills and organisational memory.

There unfortunately appears to have been significant disruption after departure of the former BCH Director and technical staff in 2006, however. Interviewees referred to loss of Project information resources with the departing staff, principally documents for which only a single hard copy existed. Soft copy data originally lost was apparently mostly retrievable from the network drives, which simply required time to search and re-file.

Some fee-based work carried out under BCH was taken over by the departing staff in their independent roles. While this is reasonably consistent with the aims of the Project refocusing, former BCH staff referred to time-consuming disputes over payment for work done to date. The loss of contact with key plant owners, such as for Mungcharoen Green, may also have introduced a barrier to sharing BCH experience and providing a demonstration case through these plants directly assisted through the Project.

Personnel changes are widely agreed to have impeded Project implementation, with new recruitment of highly qualified personnel seen as difficult. Respondents provided a range of opinions on the seriousness of such staff turnover in hindering the achievement of Project objectives – up to being the most significant challenge facing effective implementation of the Project. Two main, Project-specific contributory factors to staff turnover are identified:

- The short-term funding cycle was a significant constraint in recruitment, which could have been better managed through improved clarity on how to achieve Project financial self-sustainability.
- The change in Project focus in 2006, though a necessary adaptation to the changing market context, removed from the scope of the Project the plant-specific technical work of interest to the majority of staff so far recruited. A Project design that better anticipated the possibility of a change in RE sector demands could have reduced the contribution of this factor to staff turnover.

Staff recruitment and retention is further discussed under lessons learned and operational recommendations, in Sections 6.3 and 7.3 below.

Feedback from interviewees reflect good in-house collaboration among the four cells in the second phase, without the issues with coordination between cells noted for the first phase in the mid-term evaluation. Weekly meetings between all Project staff are held. Most current staff interviewed have worked in BCH for 3 years or less and appeared content with the workplace environment and type of work.

3.4 Activity-based Budget, Procurement and Disbursement

Financial reporting to UNDP is carried out quarterly and annually. A combined delivery report (CDR) including UNDP's own Project-related expenditures is compiled based on the annual financial report from EFE. Each CDR is audited at the end of the international financial year by a commercial accountancy firm appointed by UNDP, through comparison with EFE's own accounting system.

The financial reporting system appears from such secondary evidence and the opinion of relevant interviewees to be robust.

With regard to the GEF funding budget of US$ 6.8 million, US$ 3 million (44%) was allocated for the pilot projects; approximately US$ 3.21 million (47%) was allocated for PMO and BCH expenditures, including costs for information services, regulatory, and financing related work but excluding technical services; and a further US$ 0.59 (9%) for technical support services to developers.

Total actual expenditures of approximately 6.16 US$ million (91%) were incurred during the 7.5-years of the Project up to 31 December 2008, with 100% expected to be disbursed by the end of the Project in June 2008.

Table 1 below provides a summary of the key information with respect to budget activities and expenditures as described in detail in Annexes 4 and 5. The table is presented as per the format requested in the TOR. For brevity, a numerical estimate of percentage completion of outputs is made to summarise the qualitative description in Annex 5, and explained in the footnotes to the table. Overhead expenditure is not included in Table 1, but is shown in Annex 5.

Table 1: Comparison of Planned and Actual Activities relative to Expenditure

Activity			Budget		
Objective	**Planned Outputs ***	**Actual Outputs (%)**	**As per Project Document (US$)**	**Actual Expenditures to December 2008 (US$)**	**% of Project Budget**
1: Provide relevant and useful information and services to potential biomass power developers and others	7 main outputs	90% ‡	265,000	219,200	82.7%
2: To improve regulatory framework to encourage biomass power projects	2 main outputs	100%	515,000	187,100 (342,000)	36.3% (66.4%)
3: To increase access to commercial financing for biomass power projects	6 main outputs	40%†	265,000	118,600 (205,000)	44.8% (77.3%)
4: To demonstrate the technical and financial viability and reduce risks for biomass power plants	1 main output	100%	3,000,000	3,014,100	100.5%
5: Provides relevant and useful technical services to potential biomass power developers and others.	No set outputs	100%	591,000	349,600	59.2%

Values in parentheses are refinements to the available CDR data – see discussion below.

** 'Main outputs' are first-tier outputs listed in the Project Document for each objective, shown in Annex 5, Table 5-1.*

‡ Output 7 with respect to public awareness only partially achieved – see Section 4.

† Due to change in project context, the major part of objectives with respect to IFCT could not be achieved

Annex 5 includes analysis of Project disbursements based on the data included within the annual CDRs up to the end of 2008. These are summarised both by expenditure type (e.g. staff wages, travel costs etc), as per the financial analysis included in the mid-term evaluation, and by Project activity.

Successive refinements to the financial reporting format prescribed by UNDP make it difficult to compare in detail expenditure items for all Project implementation years, so that costs have been aggregated where necessary to form comparable categories.

It is understood that the budget in the Project Document was set based on an expectation of the Project becoming, in part, financially self-sustaining by the second phase. Given this expectation, over 70% on average of each activity's budget was assigned originally to the first phase – for the four financial years up to mid 2005. Delay in starting the Project and limited staff to carry out planned activities, particularly during the second phase, both led to under-spend so that in fact 30% was spent in the first phase and the remaining 70% will be spent in the second phase. The delay of the Gulf Yala Green pilot plant, in support of which US$ 2 million was assigned, is a significant factor in such delayed disbursement.

Actual expenditures for policy and regulation work are shown at around only 36% of the respective budget in the CDRs. However, expenditures incurred through PMO time spent on this cell's work cannot be distinguished from other general PMO costs in the Project financial reports. Policy-related actual expenditure should therefore be higher than reflected by the available financial data. Based on an estimation provided by EFE based on timesheet records, around 20-50% Project Management time was involved in policy work. If 50% of relevant PMO costs are assumed to be policy-related, then policy expenditure would instead be 66% of the budgeted value, and overheads would come in slightly below budget instead of slightly exceeding the budget.

Similarly, expenditures under objective 3 are underestimated by the data available due to a lack of dedicated staff in the financial cell for much of the second phase. Instead, the BCH director also fulfilled the role of the financing cell head, with a percentage of his time was spent on this role. In this case EFE estimate that 40-45% of the BCH director's time was spent on financing cell work. If 45% of such salary costs are assumed to be finance-related, then finance work expenditure would instead be 77% of the budgeted value.

Taking into account both of the above adjustments, overheads would reduce to 93% of the budgeted value, rather than exceeding the budget by around 5% – as implied by the CDR data alone.

3.5 Co-financing

Total co-financing of US$ 90.04 million is expected by the end of the Project, compared with the GEF funding amount of US$ 6.8 million. The majority of such co-financing relates to the pilot plants and RE projects supported under the EnCon fund, which were each included as co-financing in the Project Document.

With respect to EFE activities alone, GEF funding of US$ 3.8 million is matched by US$ 2.19 million in direct co-financing of relevant EFE activities, of which US$ 0.66

million was secured after GEF funding award. Half of this additional co-financing was from EPPO and comprises funding to EFE for the complementary activities of the biomass resource study and the ESCO fund management, also helpful to providing focus and long-run sustainability to Project activities, respectively. The remaining half of additional co-financing relates primarily to DANIDA funding for additional relevant technical support work by BCH.

Total co-financing is around 3% lower than expected in the Project Document, due to the 13% lower award of subsidies from the Encon Fund to biomass SPPs given the discrete number of SPPs supported. This was partially offset by in increase in the both the debt and equity financing requirement for the pilot projects relative to the original estimate.

A more detailed tabular summary of co-financing for the Project in included in Annex 6.

3.6 Monitoring and Evaluation (M&E) Framework

The Project Document provides a framework for M&E that has been used throughout the Project, with the addition of selected indicators to provide further specific feedback on the outcomes of activities. The relevant sections of the quarterly and annual reports have been reviewed as the main M&E results for the purposes of this evaluation.

The refocusing of the Project in 2006 is seen by both BCH and EFE as the most significant example of the Project responding to M&E findings, though the type of changes that were introduced based on M&E data relate more to the existence of an effective reporting mechanism than to the specific logframe design.

The routine reporting carried out for the Project by PMO is thorough and well documented, as per the assessment in Table 2 below. The table provides further detail on the assessment of the M&E system, based on review of the reports and key respondent feedback (PMO, DANIDA and UNDP). The interviewees also did not identify any significant variation in the quality of the M&E system by specific objective. Therefore an aggregate assessment of M&E for the Project is given and provides the basis for the rating of each M&E component. The M&E Project framework is rated as Highly Satisfactory.

Table 2: Matrix and Ratings of Objectives and Outcomes for the M&E Framework

Criteria	Rating	Basis for Rating
M&E design	MS	While the M&E system appears to have served reasonably to provide supporting evidence to regular Project reporting, neither the executing agency nor the funder, to which M&E reports were submitted, found the full degree or type of detail included in the M&E system necessary, or in some cases useful, to evaluate progress in achievement of objectives. There are moderate shortcomings in the efficiency of the administrative burden imposed by such reporting, therefore, for which the value-added is not always evident. Indicators did not in many cases give meaningful feedback over whether outcomes were being achieved. For example, quantitative indicators were applied in isolation to qualitative outcomes where their use was misleading (e.g. "number of policy initiatives" – without consideration of whether such policy initiatives were significant, well designed, influential, or in what way they were discrete from other reported initiatives). Fewer, better contextualized, indicators are likely to have been more appropriate for ongoing monitoring of Project effectiveness – particularly in qualitative areas such as policy and finance. As a consequence of the above shortcomings, M&E findings were also not in an accessible, explanatory format that could readily be used by other stakeholders, such as the PSC, to keep themselves meaningfully informed of Project progress and therefore be used for steering the Project work plan. Two PSC members were of the view that the numerical targets embodied in the M&E system acted to stifle debate on Project strategy and content at the PSC meetings, since 'meeting the targets' was emphasized, even if the target was not in itself meaningful. Long-term monitoring is not explicitly considered in the Project M&E design, whereas most of the Project impacts are long-term in nature.
M&E plan implementation	HS	In terms of the standard of reporting by the executing agency within the format of the M&E design is thorough and was described by the funder as 'perfect'. The underlying record-keeping systems for monitoring data collection have not been reviewed in detail, although appear adequate from the above reporting and from discussion with those carrying out the M&E.
Overall *	HS	

** Overall rating as for "M&E plan implementation" rating above, as specified in the Final Evaluation TOR, in Annex 1*

KEY
Highly Satisfactory (HS): no shortcomings.
Moderately Satisfactory (MS): moderate shortcomings

4. Assessment of Project Outcomes

Prior to a discussion of what achievements can specifically be attributed to the Project, it is worthwhile to note the remarkable success of renewable energy promotion policy in Thailand at a national level since the Project began.

As of September 2008, some 1,618 MW of RE capacity was operational throughout Thailand, compared with 481 MW—mainly consisting of inefficient cogeneration at sugar mills—in 1999 at the time of Project design. A further 1,398 MW of RE capacity has been approved in 2008 but is not yet in operation, across all technologies. Significantly more RE plants, with combined estimates as high as several thousand megawatts have submitted applications for SPP or VSPP status that have not yet been approved.

While such achievements can be overstated, since the number of new projects submitting applications exceeds what is likely to be built, the level of activity in RE plant development is unusually advanced for the region and signals confidence in the national regulatory framework in support of renewable energy.

The general achievements of the Project in contributing to the above RE market development was described by two key PSC members as 'outstanding' and Project performance was not fundamentally criticised by any interviewee for this final evaluation. Striking achievements of the Project included the successful promotion of interest in the earliest biomass plant demonstrations in Thailand, supported through information dissemination and policy reform.

Views regarding achievements by specific objective are inherently more complex, however, with differing views on priorities and ideal approaches from different interviewees.

The Project has met, or is due to meet before completion, nearly all the basic output targets set out in the work plan under each objective. The main question addressed in assessment of the Project is not whether output levels met their targets, but to what extent such outputs were effective in achieving the outcome of barrier removal originally intended.

4.1 Achievements by Objective

BCH management ranked the different lines of work in the second phase from the strongest as follows: information, policy, technical, finance. This ranking is the same as that given by BCH management during the mid-term evaluation, except that technical work has fallen from first to third place following the refocusing.

Achievements by objective are discussed below.

4.1.1 Objective A: Build capacity to provide information and services to potential biomass power project investors

Information services are seen by many stakeholders as the Project's primary strength, and as a major contribution to removing the barrier of limited awareness regarding renewable

energy among industry and academia in Thailand.

The main information services are the newsletter, publications, web board, phone-in, and walk-in. Outreach activities comprise seminars and workshops, public education, community participation, and media activities. There are 3 main target groups: the public, potential developers, and academics.

The EFE website was remodeled in November 2008 to improve the user-friendliness of the structure and presentation, and to add links improving accessibility to specific information hosted on the external websites of EGAT (SPP data), PEA (VSPP data), DEDE (policy information) and EPPO (dispatch data).

A biomass resource study (BRS) involving five universities around the country was co-financed by EPPO and was a major new initiative of the second phase, together with the biomass manual publication. The BRS, EFE materials and an updated RE technology database were added to the remodeled website.

The monitoring system results show a much higher level of uptake for the website than originally targeted – most recently with 60,000 hits a year relative to a target of 1,500. Enquiries from developers, academics and other organisations have been at or above the target level since at least 2004, as has recorded customer satisfaction (see Annex 4 for further detail).

Information services have benefitted from greater data availability and complementary information resources as the RE sector in Thailand has evolved. The types of information provided have also been adapted to the changing sector, such as through broadening its technological scope to include solar and wind technologies.

Areas where stakeholders felt that more could still have been done under this activity were outreach to the general public, perhaps through joint media campaigns with the Ministry of Energy; and dissemination of lessons learned from the pilot plants.

4.1.2 Objective B: Improve the regulatory framework to provide financial incentives to biomass power project investors

EFE/BCH is generally seen by stakeholders as having a significant influence on the uptake by GOT of new regulation in support of RE in Thailand – in particular the revised 'adder' tariffs. Significant, specific policy achievements identified by EFE management and BCH staff from throughout the Project period include:

- Studies that formed the basis for specific technology incentives both within the revised RE 'adder' tariffs implemented in 2007 (focus in wind, solar & hydro) and the further revisions of March 2009 (focus on small-scale biomass and waste-to-energy).
- Reduction of the grid-connection fee for VSPPs from 2 million to 0.4 million Thai Baht.
- Facilitating early VSPP grid-connections through the Provincial Electricity Authority by helping overcome barriers to implementation of new grid-connection regulations.
- Amendment of the capacity limit for VSPPs from 1 MW to 10 MW

The adder tariffs are widely seen by as the primary driver for RE sector growth in Thailand, both past and future, without which the sector could not be experiencing its current success. Even a minor role in contributing towards the adoption of the revised adders of 2007 by GOT would therefore speak highly of the Project's policy achievements, and the perceived significant role played by EFE therefore represents a significant success.

On the basis of a PSC decision, the policy cell was moved in June 2005 from BCH to EFE – whilst still remaining part of the Project – to create better separation between those staff advising specific developers and those working in the interests of the sector generally.

In practice the policy cell had no dedicated staff between at least 2006 and 2009, and relevant activities were mainly implemented through independent consultants hired for the Project on a task-by-task basis, and supervised by EFE / PMO. The main drawback to such a lack of permanent staff, as perceived by some stakeholders, appears to have been uneven coverage of policy issues and low public visibility of the policy work that was carried out.

While EFE is independent of GOT, its close ties to EPPO and ongoing apparent status as preferred provider for policy studies from EPPO effectively justifies the label "quasi non-governmental organisation" (QUANGO). The positioning of the Project's policy cell within EFE, combined with EFE's status as a QUANGO, was described by stakeholders as 'ideal' and a 'big privilege' for policy work due to the combination of independence and influence this provides.

4.1.3 Objective C: Increase access to commercial financing for biomass co-generation and power projects

The main activity under the financing cell throughout the Project was RE training seminars, which were conducted in six-seven local banks including SME, TMB, KBank, BAY, and Bank Thai. Similar to the policy cell, the financial cell had no dedicated staff for most of the second phase (though the BCH director also filled the role of financing cell head), during which period university-based specialists were subcontracted to assist in delivery of the training seminars. Up to around 40 staff from banks or other financial institutions were trained every year from 2003 to 2008.

A challenge in carrying out such training seminars was the rapid turnover in bank personnel, with individuals trained in assessing and mitigating the financial risks of RE technologies rotating out to different bank departments with unrelated functions. This challenge partly relates to an issue of industry scale, with the RE sector needing to attract greater financial flows to justify dedicated teams within local banks. The bank staff interviewed commented that most small RE projects are difficult to finance without parent company guarantees, and that small biomass and biogas projects comprise the majority of prospects presented to banks from developers. The Project therefore faced structural challenges in delivering services to improve access to commercial financing.

In addition, a central role of the financing cell envisaged in the original Project design was collaboration with a dedicated RE team at the IFCT – which functioned as a development bank for GOT. Training for the IFCT team took place early in the Project,

but in 2003 the IFCT was merged with a commercial bank, TMB, and could no longer play its foreseen role. Institutional changes therefore undermined this approach towards financial barrier removal, and no suitable alternative approach was identified.

Irrespective of such challenges, a large and increasing number of RE projects have received financing in Thailand, with at least 10 local banks providing such finance, and also building their capacity through such experience. While financing remains a barrier for small projects, access to commercial financing is not generally seen as a barrier any longer for well developed SPPs or larger VSPPs.

Additional activities by the financing cell have included:

- Matchmaking between developers and banks for project financing, with an average of five business plans from developers received each year and several successful examples of project financing noted.
- A simple template financial model was made available on the EFE website to help project developers make an initial assessment of financial viability for new plant proposals.
- A study on risk credit guarantee facilities was drafted in 2006 and is currently being updated for issue to the UNDP in June 2009.

Banks interviewed were positive about the general increase in awareness of, and financing activity in, the RE sector – which was seen to have "transformed" over the eight year span of the Project.

4.1.4 Objective D: Facilitate the implementation of two initial biomass power plants which will reduce risks associated with the deployment of this new technology in Thailand

EFE has fully met its duties under Objective D to facilitate the implementation of the two initial biomass power plants (pilot plants) and to monitor their progress.

Outside the control of EFE, and to some extent even outside the control of the Project design, is how effectively these pilot plants were able to reduce the risks associated with the deployment of further biomass power plants in Thailand. The pilot plants are Roi-Et Green in North-East Thailand, using rice husk as a fuel, and Gulf Yala Green in Southern Thailand, using rubber wood residue as a fuel. Background information, achievements and lessons learned from these two pilot plants are further discussed in Section 5.1 and Annex 7.

The demonstration value of the pilot projects is complex, and based on feedback from interviewees, objective D has been subdivided. This objective is given in full in Annex 1 as "facilitate the implementation of two initial biomass power plants through support for commercial guarantees which will reduce ***technical*** risks associated with the deployment of this new technology in Thailand".

This compares with the following, fuller description from the Project Document.

Immediate Objective: "To demonstrate the ***technical and financial*** viability and reduce risks for the biomass power/co-generation technologies… [through] completion and monitoring of the two pilot plants"

Expected Project Outcome:

"Successful demonstration of the pilot plants

1) The success of the pilot plants will demonstrate the technical and commercial viability of biomass power plants in Thailand and Southeast Asia.
2) The success of the pilot plants will demonstrate the power project development model and process for other potential IPPs and biomass industry owners/managers.
3) The success of the pilot plants will increase the confidence of the potential investors and financiers in biomass power projects.
4) The success of the pilot plants will reduce future perceived technology risks associated with biomass power and co-generation technologies in Thailand and Southeast Asia.
5) The success of the pilot plants will become a showcase for the Clearing House to promote and disseminate experience and lessons learned in Thailand"

A number of interviewees stressed a distinction between whether the pilot plants themselves are an effective showcase that provide a demonstration to the sector, and whether the risk guarantee facility used to support the projects can be considered part of such demonstration value. The objective has therefore been subdivided in the 'ranking' assessment below to capture this important distinction, as follows:

- Objective D1: Reduce ***technical*** risks for biomass power plants in Thailand through the example of the two pilot plants
- Objective D2: Demonstrate ***financial*** risk mitigation for biomass power plants through supporting the two pilot plants with commercial guarantees

Limited success in achievement of objective D2 is mainly the result of shortcomings in the Project design, which on this specific point is inappropriate to achievement of the wider Project objectives. More detailed narrative and analysis of the pilot projects are provided in Annex 7 and Section 5 respectively.

4.1.5 Ranking Assessment by Objective

It should be noted that the rating system detailed in the TOR for this final evaluation is intended to assess "actual project outcomes commensurate with the…Project objective".

Current, available evidence on the Project outcomes is therefore assessed – rather than only whether the Project's outputs (e.g. studies, publications, workshops, reporting etc) met the stated Project requirements. For example, while BCH fully met its requirements with respect to the pilot projects, factors external to BCH's stated duties mean that the proposed outcome under this objective was not fully achieved.

It should be noted that the plant-specific prefeasibility studies carried out on a *pro bono* basis by BCH's technical cell is not explicitly covered by the objectives included in the TOR for this final evaluation, but should also be considered as delivering value in

removal of technical barriers to deployment of renewable energy plant in Thailand among first-time plant developers.

Ratings for the four main objectives are shown below in Table 3: Matrix and Ratings for Main Project Objectives and Outcomes.

For further detail on the assessment method used in Table 3, please see Annex 1. For further data regarding outputs and their related outcomes, please see Annex 4.

Table 3: Matrix and Ratings for Main Project Objectives and Outcomes

Objective	Criteria	Rating	Basis for Rating
(a) Build capacity to provide information and services to potential biomass power project investors	Relevance	HS	The resources provided by BCH are considered by many interviewees as 'very useful' to furthering government RE policies through disseminating key information to the sector.
	Effectiveness	S	Information is widely cited as BCH's most significant achievement. Shortcomings are evident in some areas, however, such as outreach, regular updating of information on the website and in the timeliness of publications.
	Efficiency	HS	The significant popularity and wide usage of the BCH information resources, as disseminated through EFE, means that expenditures in this area are cost-effective.
	Overall *	S	
(b) Improve the regulatory framework to provide financial incentives to biomass power project investors	Relevance	HS	EFE/BCH closeness to government policy was widely recognized, and the take-up of their study results in this area evidence of the relevance of the Project's work in this area.
	Effectiveness	S	While EFE/BCH's contribution to the adoption of the valuable 'adder' tariffs was widely cited, a range of opinion existed on the Project's broader impact on the regulatory framework (i.e. HS to MS) – a point for which hard supporting evidence of output-outcome linkages is by nature limited.
	Efficiency	HS	The support leveraged for the RE sector in Thailand by the revised 'adder' tariffs alone can be considered ample justification for the expenditures in this area.
	Overall *	S	
(c) Increase access to commercial financing for biomass co-generation and power projects	Relevance	S	Finance has been a noted barrier to RE deployment during the Project, and is believed by some to still be a significant barrier.
	Effectiveness	MS	BCH rarely had full time staff focused on this objective, which was generally ranked the weakest of its activities. Stakeholders saw a minor contribution by the Project on commercial finance.
	Efficiency	MS	RE training efforts for local lenders were undermined to a moderately significant extent by staff changes at these lenders.
	Overall *	MS	

(d1) Reduce technical risks for biomass power plants in Thailand through the example of the two pilot plants	Relevance	S	The pilot projects were consistent with national objectives at the time of Project design, although their relevance has reduced over the Project period due to market changes.
	Effectiveness	MS	Moderate shortcomings shown either in the pilot projects or, more importantly, how effectively these were showcased to disseminate best practices and lessons learned (see Section 4).
	Efficiency	S	If monitoring costs are taken as the only relevant expenditure, then the example provided to the sector was cost-effective.
	Overall *	MS	
(d2) Demonstrate financial risk mitigation for biomass power plants through supporting the two pilot plants with commercial guarantees	Relevance	MU	The withdrawal of the JBIC project financing that required a risk guarantee facility removed the facility's relevance to pilot project support. In the case of Yala Green, such support did again prove useful to secure the lender's ongoing involvement after security issues flared in the province – though may not have been essential. The relevance of a risk guarantee facility was also undermined by the lack of interest by FIs in commercial provision of such a facility.
	Effectiveness	MU	The facility is vulnerable to being 'unwound' by the parent companies, has not been widely publicized and is not expected to be replicated – and therefore provides a weak demonstration of risk mitigation.
	Efficiency	MU	There is evidence that the Yala project required financial support to go ahead, but that the Roi-Et Green project did not, so that a third of the relevant funding under the objective would have been inefficiently used.
	Overall *	MU	

** Not rated higher than for either Relevance and Effectiveness*

KEY

Highly Satisfactory (HS):	no shortcomings.
Satisfactory (S):	minor shortcomings
Moderately Satisfactory (MS):	moderate shortcomings
Moderately Unsatisfactory (MU):	significant shortcomings
Unsatisfactory (U)	major shortcomings
Highly Unsatisfactory (HU):	severe shortcomings

4.2 Assessment of Capacity Development

The Project document lays high emphasis on capacity development and provided considerable budget for this purpose. During the first phase, BCH invested heavily in training and overseas study trips for staff and partner organisations (in particular government agencies), resulting in useful knowledge and network building. The mid-term evaluation noted one caveat to the usefulness of such expenditure – that "this investment would be wasteful if BOSCH [now BCH] cannot maintain its staff".

Unfortunately, only one of the cell staff trained during the first phase were present for a significant part of the second phase. Due to the financial support for such training being mainly from co-financiers only involved in the first phase, it has not been possible to repeat such comprehensive training. Local training sessions have continued to be employed, with an average of around one event noted per quarterly report. Management and staff at BCH were divided on whether significantly more training in the second phase would have been helpful.

The benefit of capacity building in the first phase has therefore been accrued primarily by the private RE sector, where the staff that were then trained now work. Such capacity building still assists in RE sector promotion, therefore, but in a manner less targeted to the public benefit of the sector than had such skills remained at BCH.

Capacity building for external organizations through seminars continued throughout the duration of the Project, and are considered a valuable component of the Project's achievements.

4.3 Assessment of Sustainability

The requirement for financial self-sustainability of the Project after GEF funding ceases was widely recognized as a significant challenge, by stakeholders and EFE staff.

The achievements and ongoing pursuit of the objectives of the Project will be largely sustained for at least another two years after the Project ends through the ongoing programmes being run by EFE, in particular the GEM and ESCO programs, for which the skill-base and objectives are complementary to those of the Project.

The ESCO programme provides venture capital for RE plants, of which examples are:

- 9 MW plant owned by Udon biomass company in Udornthani, firing a mixture of rice husk and woodchip
- 4 MW plant firing a mixture of rice husk and cassava rhizome
- 900 kW corn cob based gasification plant
- Energy efficiency through voltage regulation in large buildings
- 8.8 MW solar farm

EFE involvement includes advising on:

- Community surveys prior to site selection, to gauge level of opposition and engagement required
- Fuel resource risk management & technology selection, including fuel flexibility

- Independent Engineer after investment award

If the project appears feasible following initial review, a proposal is submitted to the ESCO fund investment committee at DEDE. Minority equity stakes of less than 50% total investment or 50 million Thai Baht (US$ 1.4 million) are provided.

GEM is a different form of RE support mechanism, whereby corporations, other organizations or individuals make voluntary contributions towards a green energy fund, managed by a tri-partite committee of the private sector, EFE and GOT. The fund will provide investment subsidies to green energy projects, primarily at the community-scale. Example projects include micro-hydro, small wind, solar PV and waste-to-energy.

The ESCO fund manager role was secured on the basis of EFE's experience with the Project, while the GEM programme was inspired by the experience gained by EFE staff during the Project, and insight on the role that a QUANGO can most positively play in the evolving RE sector in Thailand.

UNDP approval for the Project extension of one year was largely on the basis that this additional time would enable such follow-on activities to be effectively initiated, providing sustainability to the Project. As discussed in Section 3, EFE has restructured to better integrate BCH's functions for the GEM and ESCO work.

EFE also plans joint work with the World Bank and DEDE on programmatic CDM, including a bundled set of micro-hydro power, for which "project idea notes" have already been prepared.

An EFE board member highlighted that sustaining and reinforcing the Project's achievements requires continual adaptation, to direct support to where this is most needed in the RE sector in Thailand – and therefore poses an ongoing challenge.

Information, technical and financial work are seen by EFE and other stakeholders as key to the ongoing GEM and ESCO programmes – therefore providing sustainability for these Project activities.

Policy work does not currently have dedicated funding, but is still seen as a "central activity" by EFE management. Sustained policy advocacy efforts from EFE are not in doubt given the strong interest, skills and engagement by the new Chief Executive Director of EFE, a former BCH policy officer; and the returning chairman of the EFE advisory board, a former Minister of Energy for Thailand.

In addition to consideration of whether Project outputs and activities will be sustained through ongoing programmes, a number of interviewees were asked to comment on specific risks to the sustainability of Project achievements. As per the rating structure set out in the TOR, interviewees were asked to comment on the nature and extent of likely risks with respect to each of four dimensions of sustainability. A matrix and rating for the assessment of sustainability of the principal Project objectives is shown in Table 4 below, based on interview results.

Table 4. Matrix and Rating of Sustainability of Project Objectives

Objective	Criteria	Rating	Basis for Rating
(a) Build capacity to provide information and services to potential biomass power project investors	Financial resources	L	The main identified risk is EFE lacking a budget to maintain the information services, which was considered unlikely.
	Socio-political	L	The main risks are that the information becomes redundant, is not updated, or is no longer used – considered unlikely.
	Institutional framework & governance	L	No identified risk to information services.
	Environmental	L	No identified risk to information services.
	Overall *	L	
(b) Improve the regulatory framework to provide financial incentives to biomass power project investors	Financial resources	L	Main identified risk is withdrawing of public support for RE plant, such as the BOI special privileges – thought unlikely
	Socio-political	L	No significant source of public opposition to renewable energy support policies, ongoing media campaign to assist.
	Institutional framework & governance	L	Improvements already made secure. Interest in ongoing role for EFE, as effective QUANGO, from EPPO and EFE.
	Environmental	L	No significant further risks of environmental regulation imposing barriers to RE plant envisaged.
	Overall *	L	
(c) Increase access to commercial financing for biomass co-generation and power projects	Financial resources	ML	Main identified risk is scarcity of credit to RE projects due to poor health of either the local or global financial markets.
	Socio-political	L	Previous training work with bankers being reinforced by ongoing ESCO work, mitigating risk of bank staff turnover.
	Institutional framework & governance	L	No identified risk to commercial project finance services.
	Environmental	L	No identified risk to commercial project finance services.
	Overall *	ML	
(d) Facilitate the implementation of two initial biomass power plants which will reduce technical risks associated with the deployment of this new technology in Thailand	Financial resources	ML	Possibility of high biomass prices undermining financial performance of the pilot projects and new proposed plants, despite the strong support available through the revised 'adder' tariffs and CER sales.
	Socio-political	ML	The possibility of protests by local communities could still pose a risk to further roll-out of plants based on the demonstrations.
	Institutional framework & governance	ML	Some respondents expressed concerns over the stability of adequate support through energy policy in the current global financial climate and given changes in the Thai government.
	Environmental	ML	New plants generally meet high environmental standards, and are subject to a good standard of regulation, but enforcement of regulation is not always sufficiently strict.
	Overall *	ML	

** Overall rating not higher than for any of the corresponding four dimensions of sustainability*

KEY

Likely (L): There are no or negligible risks that affect this dimension of sustainability.

Moderately Likely (ML): There are moderate risks that affect this dimension of sustainability.

4.4 Assessment of Catalytic Role

Potential catalytic effects considered and examples of where the Project demonstrated such effects are summarised in Table 5.

Table 5. Indicators of Catalytic Effects Based on Project Outcomes

Catalytic Effect	Example(s) of how Catalytic Effect Was Demonstrated
Providing a model for similar initiatives in other sectors, or the RE sector in other ASEAN countries	An initiative in Malaysia in 2005/2006 took inspiration from BCH and began a QUANGO similar to EFE, which was after two years reabsorbed into the Malaysian government.
Providing the basis for future programs in the RE sector in Thailand	The idea of the GEM evolved from and continues the work of the BCH – so that the Project both catalyzed a new initiative and its objectives are sustained by this ongoing new program. EFE is also seen to have the credibility and knowledge to implement the ESCO program largely as a result of the Project.
Incubating the skills, later taken outside of the Project itself, for independent work in RE deployment	Staff that have left BCH often took their newfound skills and knowledge to financial and industrial employers, to some extent catalyzing new plant developments.

The Project is seen to have a number of catalytic effects, the most significant of which are the ongoing RE-sector programmes that also provide the basis for the Project's ongoing sustainability (as described above).

4.5 Assessment of Leverage for Additional Funding

The most significant leverage of additional financing that can be attributed, at least partially, to the Project is the introduction of the revised "adder" tariffs in 2007. It is difficult to estimate what new investment in RE generation was stimulated by such new incentives.

Table 6. : Investment Cost for Renewable Energy Power Plant in 2007-2008

Fuel Type	Specific CapEx ‡ (US$/kW)	Newly Installed Capacity (MW, 2007)	Newly Installed Capacity (MW, 2008)	Investment Cost (US$ million)
Biomass	2197	174.7	379.16	1,217
Biogas *	520	7.51	7.304	7.7
Photovotaic	7840	1.326	0.266	12
Wind	1760	0	0.08	0.14
			Total	1,237

‡ *Source: World Bank's Study of Equipment Prices in the Energy Sector Report and MM benchmarking data*

** Gas engine and balance of plant only, given wastewater treatment is regulated under Thai law*

Table 6 provides an estimate of the total investment costs related to newly installed RE plant capacity in Thailand during 2007 and 2008, during which time 570 MW of new SPP and VSPP plants came online. In total, an order of US$ 1.2 billion is therefore estimated to have been invested in RE plant beginning operation since the revised "adder" tariffs were introduced.

It can be argued that such investments were stimulated by the upcoming prospect of the revised "adder" and therefore to some degree additional project finance in the sector was leveraged by the Project's activities.

An alternative approach to analyzing the same point would be to assess the concessional tariff awards to SPPs and VSPPs since the revised "adder" tariffs of 2007 came into force. From available public data, concessional tariff awards equivalent to US$ 32 million have been awarded to such new RE plants commencing operation since the revised "adder" tariff was introduced.

4.6 Assessment of Public Awareness

There is generally seen to have been a major increase in general public understanding of renewables so that "people know more about biomass and now RE" now than in 2001, when the Project began.

The main media activities related to the Project have been radio talks and newspaper articles by the chairman of EFE's advisory board. Outreach by BCH has been focused on the specific communities local to new plant developments that BCH were involved with. Significant distribution of the material on EFE's website to other online forums is a further example of the Project's influence.

Complementary activities in raising public awareness include work by environmental NGOs, plus seminars and television advertising campaigns from the Ministry of Energy (DEDE and EPPO).

While general public awareness regarding RE has increased, there were varied views regarding the extent to which this awareness extends to the rural communities typically hosting new plants. Some staff considered that public education had to be begun afresh for each new community in the area of a potential new RE plant.

Although RE does not now face such strong opposition as gas and coal based plant, a major barrier to ongoing RE plant development is still opposition from local communities. There is seen to be an outstanding need to overcome the poor example of early biomass plants through publicising recent best-practice examples, and to build local community's confidence in the government-regulated system for assessment of environmental impacts.

5. Review of Pilot Projects

5.1 Demonstration of Best-Practice

Review of the Gulf Yala Green (GYG) and Roi-Et Green (REG) pilot plants has highlighted examples of both good and best practice, as well as lessons learned, relevant as a demonstration to subsequent biomass plants.

The Gulf-owned pilot plant was originally intended during Project design to be Huai Yot, located at Trang. Another site was selected due to a more favourable community response in Yala.

Annex 7 provides further background information together with an overview of plant performance in each of the following areas:

- Project technical profile – development and operation.
- Project commercial profile – fuel risk management and meeting debt service.
- Environmental impacts.
- Community engagement.

Both plants were supported by GEF through the Project, by contributions to fees for a "risk guarantee facility", discussed below. The two plants are referred to within this report as "pilot plants" for the fact that these were intended to pilot commercial scale application if existing biomass technology, rather than for the typical use of this terminology to reflect small-scale technology trials. Both pilot plants employ commercially available biomass-fired power generation technology (though not necessarily widely proven), and also aimed to demonstrate the early application of such technology in Thailand.

The role for an effective, publically-accessible demonstration of best-practice biomass generation is shown by the biomass plant in Chainat owned in Biomass Power Company Ltd, a CFB boiler firing rice husk of 6 MW capacity that was installed in central Thailand in the early 1990's, and which had both high emissions to air and very low technical reliability. This precedent was referred to by several interviewees as creating widespread wariness regarding biomass among both investors and local communities for potential new biomass plant developments. Other less publically known biomass plants seeking to use advanced combustion technologies in the 1990s are also known to have suffered poor technical performance early in their life.

A counter-example through a pilot plant, demonstrating best practice, therefore had potential to serve a valuable role when the Project was first being designed in 1999.

Since the REG power plant has been developed, the number of biomass power plants which use rice husk as a fuel has increased in the Northeast area with REG used as an example by a number of developers, including Mungcharoen, Bua Somai, Satuk and Uthong. REG's experience has been widely publicised through conferences, visits to the plant site by other developers and through BCH recommending other developers to talk to REG management. The plant also received a national prize for on-grid renewable power generation.

At the time of the mid-term evaluation, in early 2005, REG had recently begun operation whereas GYG was still under construction. The following 'issues for consideration' were highlighted in the mid-term review:

- *The first demonstration plant and the risk guarantee fund did not constitute an important factor in promoting biomass power plants in Thailand. This was evident in the establishment of other biomass plants without any risk guarantee subsidy at the same time as the project's first demonstration plant. Four other biomass power plants commenced operation in the same year as the Roi-Et Green. These plants are therefore a better demonstration of the technical and financial viability of biomass power plants.*
- *The second pilot plant has been delayed for a long time. It is no longer a factor in the promotion of biomass power plants.*
- *During April 1999 to December 2003, the number of SPP projects from biomass and other alternative energy that have received EGAT's PPA pledge increased from 26 to 53, indicating the potential developers' willingness and readiness to enter this business.*

The mid-term evaluation effectively argued that the pilot plants came too late, and recommended that the "pilot plants are unlikely to yield significant impact and the… [refocusing] should not place too much emphasis on this component" in the second phase. The counter-argument to the above is that the pilot plants provided a better example of good practice than others being developed in parallel, both through their performance and how well such performance was publicised, which could still improve the quality and number of new developments.

The relevance of the pilot projects can also be criticized for the following reasons:

- A shift in demand towards smaller scale plant than the pilots, due to fuel security concerns, rendering medium- to large-scale demonstrations less pertinent.
- A comparable, equally well-performing, demonstration began operation in 2005 at A.T. Biopower's Pichit plant, in central Thailand, also fired with rice husk.
- A shift to development of biomass plants by agro-industry, which own the feedstock, rather than power utility companies such as those that developed the pilot plants, which changes the allocation of fuel price risk.
- Sharing of knowledge between agro-industrial companies, e.g. rice millers and palm oil millers, reduced the need for a publically-supported showcase.
- REG not necessarily providing a best-practice example of technology, environmental impact or fuel price risk mitigation (see Annex 7).
- The location of the GYG plant offering a poor showcase due to the security situation in Yala province resulting in few visits from outside the province.
- The risk guarantee facility being an unlikely commercial solution to fuel price risk mitigation, which would therefore be replicated independently of GEF support.
- Fuel price risk mitigation through fuel-flexible boilers being effectively demonstrated by a range of plants as a more effective solution than a risk guarantee facility.

The above criticisms are generally valid, and show in hindsight that the pilot projects inclusion in the Project design was not optimal. Nonetheless, the pilot projects have served a useful role. The early experience of REG, both in terms of best practice and lessons learned, has in particular served an evident demonstration value to the sector, due to the widespread showing-casing of the plant's experience. This demonstration is seen to have accelerated deployment of RE and to have mitigated risks of further negative experiences in technology roll-out by agro-industry. GYG's experiences, while equally instructive, have unfortunately so far been less effectively broadcast.

Despite their relatively successful, although modest, impacts as demonstration projects, a more significant question is whether the financial support provided for such demonstration value was cost-effective. This point is explored through discussion of the risk guarantee facility. Project financial reporting shows that US$ 3 million of GEF funding was contributed toward these fees.

5.2 Demonstration of the Risk Guarantee Facility

The basic concept of a risk guarantee facility is that a qualified party (generally a financial institution) will take responsibility for the financial consequences of certain events – removing this risk exposure from the project company and therefore the project lender, similar to insurance. This can help to secure project financing in the case that a lender does not feel qualified to assess, or would not accept, certain risks such as fuel price fluctuations – and these risks cannot be mitigated through standard approaches of plant design, contracting, insurance or contingencies.

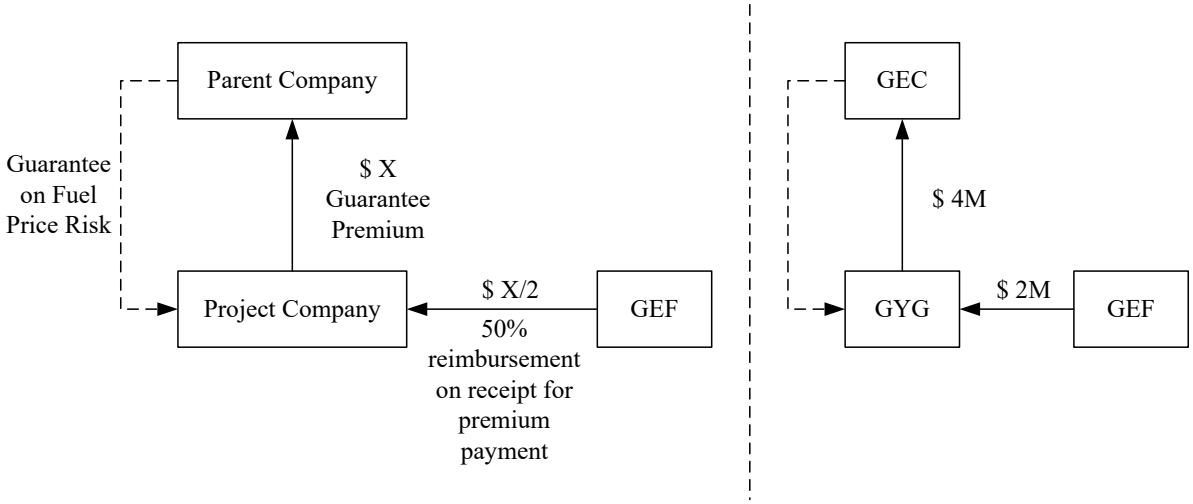
In the case of the pilot plants, the risk guarantee facility was originally requested by JBIC, which was to finance the two pilot plants (at this time REG and Huai Yot) through IFCT (now TMB bank). Based on this request by JBIC, EGCO (the parent company for the two original pilot plants) was to provide a guarantee covering the risks related to biomass fuels and IFCT the overall risks (credit, currency, technology and other risks) for the pilot projects. The risk guarantee facility was to be priced at from 3 to 3.5% the outstanding loan amount semi-annually (2% for the cost of guarantee fees by IFCT, 1-1.5% for the cost of fuel supply guarantee fees by EGCO).

GEF funding was to be used to reimburse the two project companies with up to 50% of the risk guarantee fees as contingent financing, with the total amount of support not exceeding US$ 3 million, allocated as follows:

- US$ 1 million for Roi-Et Green Co. Ltd
- US$ 2 million for Huai Yot, Power (later transferred to GYG)

Payment was to be made semi-annually on provision of the invoice and receipt from the project companies for the guarantee fee. The structure of the guarantee and reimbursement for the fuel risk guarantee facility specifically is shown in Figure 6 below, both in the general case and for GYG specifically.

Figure 6: Structure of Guarantee Facility Provision



GEF—Global Environment Facility

GYG—Gulf Yala Green, pilot plant project company

GEC—Gulf Electric Company, GYG parent company

5.2.1 Practical Critique – Implementation of the Facility

The above risk guarantee model served a clear purpose in attracting project finance from JBIC for the pilot plants at the time of Project design. However, in 2003 the IFCT was merged into TMB, a commercial bank, ending its special status as a government development financial institution. JBIC involvement in financing the pilot plants through IFCT was also withdrawn around this time. Local banks TMB and BAY instead financed the REG and GYG pilot plants, respectively. The pilot plant parent companies instead were left to provide the full guarantee facility (as per Figure 6).

With the removal of an outside requirement for a guarantee facility, and of IFCT as the one financial institution willing to offer such a facility, it appears likely that the role of such a facility should have been re-examined.

For REG, knowledgeable interviewees did not believe the guarantee facility was necessary for the plant to go ahead, since the IRR was sufficiently high without this support and the local bank did not specifically require such a facility. It was also not considered likely this the project company would use the facility in the future.

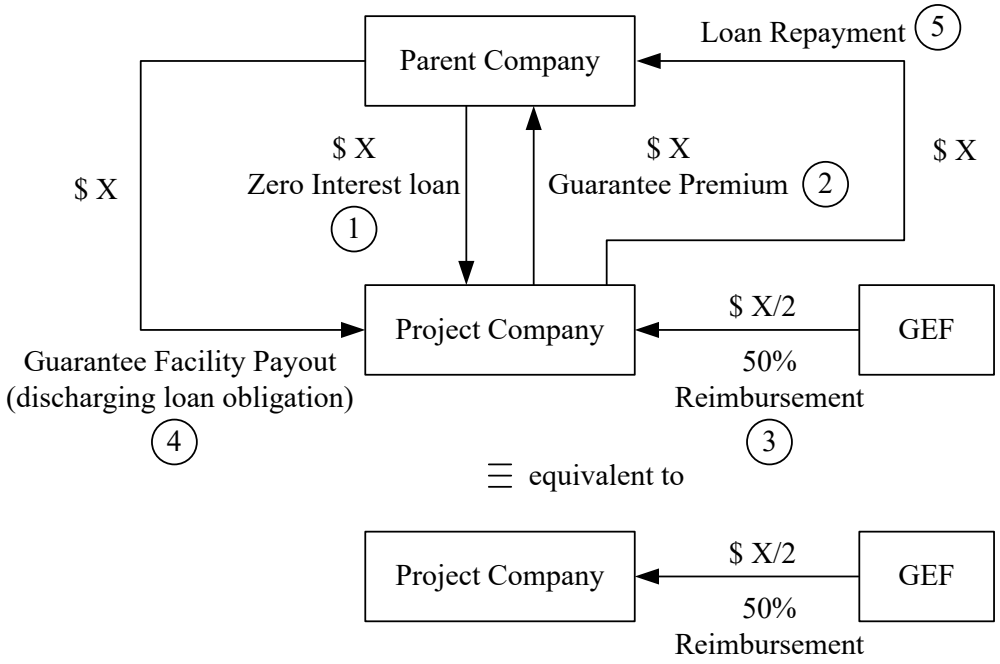
For GYG, the interviewees believed the plant could not have gone ahead without the facility, however, due to the costs and risks of the plant location. While the plant was originally financed by a local bank without the need for a guarantee facility, the bank renegotiated with the parent company, GEC, a year into construction due to a flaring of security concerns putting the plant in jeopardy. Both GYG and the bank felt that the guarantee facility was then needed to allow the project to proceed.

After the withdrawal of JBIC, the parent company was left as the sole provider of a risk

guarantee, as shown in Figure 6 above. BCH staff interviewed did not consider this ideal, but were not able to identify another financial institution that would take on the risks as formerly proposed by IFCT.

Figure 7 below shows another illustration of how the guarantee facility can lack meaning as a financial tool in the case of the parent company providing the guarantee. Through a five-step process, the 50% guarantee fee reimbursement from GEF can be made equivalent to a direct grant to the project company for the same amount. This might apply in the case that the project company has insufficient funds to pay the parent for the facility, therefore takes a parent-company loan for this – and is also paid from the guarantee facility because it is unable to meet debt service on such a junior loan. In such a case the amount of '$ X' simply circulates twice between the parent and project companies. Since these transfers of '$ X' equate to a zero net transfer, and may discharge the guarantee facility obligations in the event that a cap on payouts is set equal to the premium, the only remaining effective transfer is of '$ X/2' from GEF to the project company.

Figure 7: Example equivalence of Guarantee Facility Provision to a Direct Grant



Essentially, the facility is vulnerable to simply being 'unwound' after plant operation through the nature of the guarantee facility agreement and other parallel agreements between the parent and project companies – unless such agreements are in some way controlled. Specific points that could potentially be better controlled to mitigate such vulnerability in the event that a parent company is providing the guarantee facility include:

- Definition of risks covered by the facility.
- Clear criteria when a drawdown on the guarantee facility would apply (i.e. when the risk covered reached an unacceptable level) – based on fuel price indices or ability to meet senior debt service.
- Definition on cap (or lack thereof) for payouts from the guarantee facility

- Definition of premiums in relation to cap on payouts (i.e. premiums should be less than cap by some order, to reflect extent of risk being covered).
- Requirement for the parent company to maintain an Escrow account for funds within the facility.

For both pilot plants, several interviewees saw the risk guarantee facility as, in effect, an opportunity to provide a cash grant to the parent or project company, to improve project viability. It is possible, given the above vulnerabilities in Project design, that agreements between the parent company (guarantor) and project company may have been structured so that this is how the facility worked in practice.

It therefore appears likely that the risk guarantee facility as a means of financial risk mitigation was not effectively demonstrated by the pilots. The main point where such a facility can definitely be seen to have delivered value is in allowing GYG to secure debt funding to complete plant construction. Project management at EFE considered that the pilot projects are a "special case" that could not easily be replicated, and that any similar future guarantee facility would need to be "carefully designed".

One further drawback to the guarantee facility is that it barred the projects from registering as CDM projects – since the plants were already in receipt of donor support. While the possibility of such registration was uncertain at the time, it should in hindsight have been possible. At a US$10 CER price, each plant could have received the same amount of revenue as made available through the GEF fund within 4 years.

5.2.2 Theoretical Critique – Concept of the Fuel Risk Guarantee Facility

Fuel price risk was widely cited by interviewees as the major barrier facing individual project developers, and was an intended focus for the risk guarantee facility. It was acknowledged by a number of interviewees that if a cost-effective means of mitigating fuel price risks through financial instruments could be demonstrated, this would be valuable to future biomass power plants.

For replication of the risk guarantee facility without subsidies, by the private sector, a financial institution or other guarantor would need to be better able to manage fuel price risk than an individual plant, in the similar way as an insurance company can better manage the aggregate risk of (a generally large number of) insured parties. Challenges to such risk management are posed by the specific nature of biomass feedstocks as used in South-East Asia when compared with, for example, fossil fuels. Characteristics of biomass feedstocks in the region include:

- The low bulk density of biomass residues makes transportation costly, per unit heating value of fuel, relative to fossil fuels.
- Some biomass residues degrade or suffer self-heating effects that can lead to spontaneous combustion – in this case handling complexity further increases the transportation cost barrier.
- Biomass residues are typically only aggregated in relatively small quantities compared with fossil fuels making bulk transportation, e.g. by rail or ship, impractical.

- Greenhouse gas emissions associated with transportation of biomass residues prior to combustion as a renewable fuel must be accounted for under the CDM, reducing the value of the feedstock for revenue generation the further its is transported.
- There is no open market for biomass residues typically used in power generation in Thailand, but instead the residues are generally traded on a bilateral basis or via brokers and independent aggregators.
- The above constraints mean that biomass residues are typically a non-fungible good, for which accurate market pricing data is scarce, and that where such pricing data does exist it is difficult to translate to a specific user.
- Without accurate information on biomass market price variations over time as applicable to a given user, a financial institution has no better fundamental basis on which to assess risk than the plant owner or his consultant does from surveying the local resource supply quantities and potential competing demands.

On the basis of these points, it is not clear how a parent company or financial institution would be better placed to manage fuel price risks in most cases than the project company, which generally has better access to relevant information. Should a biomass fuel risk guarantee facility become available in Thailand, it therefore appears unlikely that this would be a competitively priced means of fuel price risk mitigation, compared with fuel supply management by the plant.

This finding is based on interview responses combined with the evaluators' own observations as a participant in unrelated biomass plant developments in Thailand, and has been used in assessment of the relevance and cost-effectiveness of this Project's objective (D2).

Alternative fuel risk management approaches were proposed by the interviewees for this final evaluation. One such proposal was introduction by government of local buying pools for biomass feedstocks – which would help to control prices and to prevent unnecessary long-distance transport of biomass residues when other buyers could be identified closer to the biomass source. Such models could perhaps be explored, or have been explored under the Project, as an alternative to the risk guarantee facility.

The evaluation team has not yet had the opportunity to review the risk guarantee study currently under preparation by BCH, and would be pleased to receive further specific feedback on the logic of the above findings related to the findings of this study.

6. Lessons Learned

Lessons learned and best practices are based on an extensive review of the Project's documentation over its eight year duration, interviews and focus group sessions with stakeholders and project staff, and observations of the evaluation team. As this is the final evaluation, less attention has been given to process issues with respect to on-going implementation. Instead, the major aim of the evaluation is to highlight (1) lessons learned for the future promotion of power generation and co-generation for both biomass and other renewable energy sources in Thailand; and (2) lessons learned for the application of the Project's experiences in other countries and regions.

One of the challenges faced by this evaluation has been limited personal and institutional recall of early stages in the Project, due to a combination of the long, eight-year Project span and a high related turnover in the broad set of Project participants since the Project first began. The following lessons learned, mainly highlight the flexibility and adaptive practices undertaken by the Project's staff and policymakers to address a rapidly changing market context for biomass power generation and renewable energy promotion over the past 3-4 years during the second phase of the Project. The experiences of the Project with respect to the required flexibility in Project work plans, personnel change, changes in client needs and perceptions, and effective M&E procedures in a dynamic project context provide important lessons for project implementation practices in general, as well as future project design considerations for RE energy projects specifically.

6.1 Need for Flexibility in Project Design to Adapt to a Rapidly Changing Context

Within the scope of the four broad objectives of the Project, a significant refocusing took place in early 2006. This refocusing consisted of two key elements:

1) An effort to emphasize work in the common, public interest rather than fee based work that focused on specific developers; and
2) Formally broadening the Project's scope from an emphasis on biomass only to include all renewables, with particular emphasis on small scale power generation.

The change in scope and focus had major impacts on staff retention and staff recruitment, changes in the number and backgrounds of relevant Project stakeholders, changes in the work plan, different emphasis on policies and regulations, and a significant shift in project beneficiaries from clearly identifiable community residents and biomass plant operators to a more diffuse group of interested parties indirectly influenced by changes in renewable energy programs and policies.

As discussed in Section 2: Project Context & Adaptation, the Project was partly a "victim of its own success" in promoting renewables. Early success in encouraging biomass plant mainstreamed the technology and swiftly removed significant barriers. Instead of following the action plan provided by the Project Document, the Project had to adjust its focus to smaller scale biomass plants and other RE technologies, requiring new skills and approaches.

In pursuing this broader scope during the second phase, Project management has effectively targeted resources at activities of public value, which have attracted positive

feedback from a range of stakeholders. The rapidly changing context has posed significant challenges to the Project as it was structured, however, particularly felt through the major loss of staff following the refocusing in 2006 which in part related to the change in focus since it removed from the scope of the Project much of the plant-specific technical work (fee-based) of interest to the majority of staff so far recruited. Staff limitations are seen to have prevented Project take-up of potentially desirable additional activities in the second phase (e.g. following up developer enquiries, public awareness campaign, work on a broader range of project technologies including waste-to-energy) despite the availability of budgetary resources to do so within the original seven year term.

An almost universal theme raised by funders, other stakeholders and senior level EFE/BCH staff interviewed was the flexibility of the Project – each respondent saw barriers to constructive adaptation of the Project to reflect changing circumstances and ongoing findings. Different respondents identified the major barrier either as limited proactive generation of new proposals to the donor by the executing agency, or limited donor flexibility to change how funds are allocated given initial exploration of proposals to adapt to changing circumstances.

It is however fair to say that EFE has shown a proactive approach towards securing the Project's future through establishing ongoing, relevant RE sector programmes for the post-Project period, through the GEM, securing the ESCO fund manager role and other activities such as programmatic CDM.

These examples suggest that the organizational dynamic between UNDP/GEF and EFE, rather than EFE's own approach alone, is responsible for any lack of dynamism in responding to the full range of opportunities for relevant work in the second phase. The personal relationships between UNDP and PMO staff are currently strong and constructive, and appear to have been effective at responding to change. Some combination of a less dynamic relationship with former UNDP staff and the complexity of GEF procedures for reallocating funds to activities outside the originally approved Project scope, appear to have stifled potentially productive ideas for change early in the Project.

A lesson learned is that projects that are specifically designed to establish a collaborative partnership between public institutions and private sector entities should anticipate the need for project adaptation, including changes in the project's scope and objectives, incorporation of new institutional entities and revisions in financial requirements.

Donor-financed projects involving public-private partnerships are thus more likely to be shorter term or may require breaking down the larger project into project subcomponents that that can be "spun off" when objectives are reached to enable subcomponents to continue independently perhaps under private sector management. This type of adaptive project design modality would allow resources to be directed to the most financially efficient objectives as determined by the evolving role of the private sector, while concurrently providing economically viable benefits to the society.

A further specific example of a change in Project objectives that may have provided greater benefits to the RE sector given changes in the market, is to withdraw the support for the pilot plants once it became clear their role was being eclipsed, and redirect this

towards support for as-yet undemonstrated RE project types. Greater consideration could have been given to this possibility following the withdrawal of the Huai Yot pilot plant, for example, before redirecting the full amount of such funds to the substitute GYG pilot plant.

6.2 Need for Upfront Clarity in Seeking Financial Self-sustainability

The career uncertainty associated with the short-term funding cycle was identified as a significant constraint in recruitment, which could have been better managed through improved clarity on the intended model for long-term self-sustainability of the Project.

While financial self-sustainability for the Project after the completion of GEF funding is seen as a worthy aspiration, a number of EFE staff and key PSC members believed that more explicit direction on how to achieve such self-sustainability should have been included in the Project Document – to help avoid the conflicts experienced by the Project over the extent of fee-based work carried out, and to provide a clearer long-term vision of financial stability.

The use of other publically funded programs for the post-Project period is seen as positive by funders, with "no other options" for financial self-sustainability seen to be available. If this was always the likely intended model for financial self-sustainability, a clear understanding of this fact from the beginning of the Project might have helped avoid the major loss of staff in 2006 that accompanied refocusing to reduce fee-based services. Specifically, the refocusing required to adapt to changes in the market would have been less severe had BCH and UNDP expectations regarding the role of fee-based work in achieving financial self-sustainability been better aligned from the start of the Project.

6.3 Staff Recruitment, Development and Retention to Ensure Effective Implementation

Personnel changes are widely agreed to have impeded Project implementation, with new recruitment of highly qualified personnel seen as difficult, particularly when the Project was thought to have only two years left, following the major staff losses in 2006. Strong competition from the private sector for the skills required was noted as a challenge in both recruitment and retention.

To highlight the importance of staff retention, several stakeholders stated that while Project management was generally seen as strong, they had criticisms regarding the skill-base of BCH cell staff, particularly following 2006, for being too junior or insufficiently technically experienced to offer well-grounded *pro bono* technical advice to developers.

The major lesson learned with respect to staff retention relates to the initial two lessons regarding better upfront clarity on intended long-run sustainability (and therefore staff employment prospects) and the need for flexibility with respect to Project adaptation and change. It is essential that personnel policies and efforts to retain Project staff are undertaken in concert with proposed changes in work plans and programme objectives. Also, recruitment programmes to ensure an overlap between departing and incoming staff can help to avoid a loss of knowledge and skills due to staff turnover.

6.4 Dealing with Technology Choices and Risk—Need for a Broader RE Focus

As noted in the statement describing the Project background, at the time of its design it was envisioned that Thailand faced a future with substantial unexploited biomass resource potential—principally from bagasse, rice husk, palm oil waste and wood residues. Barriers to realizing this potential for power generation were considered to be mainly (1) lack of information and services to the potential biomass power and co-generation developers, including successful demonstration models, and (2) lack of appropriate financing mechanisms to support biomass co-generation/ power projects.

Within a couple of years following the initiation of the Project, Thailand's biomass situation changed from one of plenty to scarcity. Such scarcity was largely due to the expansion of the industry on a nationwide scale. More important was not scarcity, but the uncertainty of supply of sufficient quality to meet the demands for relatively large scale biomass operations. To readily achieve financing, EFE/BCH concluded that it is necessary for potential developers to have the ownership of raw materials.

One of the responses to the uncertainty of suitable biomass residue supply has been recommendations to expand the scope of the Project to include other renewable energy. Wind and solar have good potential, but require strong policy support, advocacy and dialogue among the parties concerned as well as public awareness and an educational campaign. Over the past two years BCH has built up its technical expertise through studies and training to serve as a useful multidisciplinary resource for promotion of small scale RE projects. It is important that this technical expertise and personnel be recognized as potential valuable institutional resource that should continue to receive public financial support following the termination of the Project.

One alternative energy technology where the Project could also have focused, requiring similar skills to biomass and biogas plants, is waste-to-energy – a currently emerging area in Thailand. UNDP and EPPO representatives highlighted the following potential benefits to further effort in this area:

- A potential role for EFE, playing to its strengths as an organization, as a bridge between the public and private sector – to facilitate cooperation between provincial administrations and private developers.
- Need for assistance from provincial administrations in appropriate technology selection.
- Significant social and local environmental benefits to improved waste disposal systems.

6.5 Need for More Detailed Upfront Research in Project Design

While the Project would have benefitted from building in more flexibility to changing the sector focus, it could also have benefitted from more accurate information regarding the current status of the biomass sector in Thailand prior to Project design.

More accurate information regarding the biomass resources available in-country and current biomass plant deployment could have enabled a more accurate assessment of specific barriers to be tackled within the scope of the four main objectives, and potentially more cost-efficient approaches to tackling such barriers.

In particular, a number of interview respondents felt that too much effort was put into services and staff training relevant to large-scale biomass plants early in the Project, given that:

- There was limited scope for high numbers of new large-scale biomass projects due to feedstock constraints. This limitation represents an early 'lesson learned' for the Project, but is also a common pattern with commoditization of agricultural residues visible at the time from other countries. Several stakeholders highlighted the lack of reliability of GOT agricultural statistics for calculation of available residues – more accurate resource levels could potentially have been identified by independent study in advance of designing a long-term Project.
- Biomass plants at this scale proved to be commercial or near-commercial without external support.
- Efforts were initially targeted at the power-sector (e.g. the pilot plants) rather than the agro-industrial companies that controlled the feedstock, and which were therefore best placed to develop projects with low fuel supply risks.

The Project Document appears to assume that no large biomass plant using advanced combustion technology were present in Thailand at the time of Project design. It is more accurate to say that such plants existed, but were not yet operating with high reliability or sharing information that could provide a demonstration to Thai industry as a whole. One example is a biomass plant that began operation in 1996 at Advance Agro's pulp and paper processing facility in Prachinburi Province, using a BFB boiler firing a mixture of rice husk and eucalyptus bark and with nominal capacity of 37.5 MW. A further example is the 6 MW plant installed in central Thailand in the early 1990's by Biomass Power Company Ltd, with a CFB boiler firing rice husk.

If medium- to large-scale biomass plants were to constitute the Project's original focus, the Project designers could perhaps more cost-effectively have sought to work with such existing plants – to improve performance and publicise the findings – rather than to support the new pilot plants being developed by the power industry – with the associated risks of new Project development and lack of feedstock control.

It is perhaps easy to identify these points in hindsight, and would have been difficult to gain independent yet well-informed advice on the state of the nascent sector at the time of Project design. Still, a lesson learned remains that more detailed, independent upfront studies to verify key assumptions could play a role in better targeted Project design.

6.6 Outstanding Barriers to RE Plant Development

Technical barriers to biomass and biogas specifically are generally no longer seen as significant provided project owners use credible equipment suppliers. Sharing of experiences among agro-industrial companies has also helped mitigate technical risks and shift the need for BCH's support role to smaller scale developments – where it is now active not only in biomass co-generation, but in small scale wind, hydro and solar projects as well.

A large and increasing number of RE projects have received financing in Thailand, with at least 10 local banks providing such finance, and building capacity through such experience. Banks considered that RE projects proposed by small companies can still be

difficult to finance, although not significantly more so than projects with similar sponsors in other sectors, and were positive about the general increase of financing activity in the RE sector—which was seen to have been "transformed" over the eight year span of the Project. Financing barriers specific to RE are seen as minor relative to the information, technical and policy barriers – with a well developed, commercially robust project able to attract financing as readily as in more established infrastructure sectors.

The evaluation suggests that various barriers remain inhibiting the continued exploitation of renewable energy as a source for power generation. The outstanding constraints on renewable energy development in Thailand requiring further effort to remove include:

- Accurate, updated information on available natural resource levels through public studies and information resources to aid developers in plant site selection and, for biomass power, in feedstock selection.
- Ongoing, predictable regulation of RE policies and sector support programmes, without a limit to RE capacity, and with attention given to effective implementation, incorporating feedback from plant developers about ongoing challenges.
- Weak relations between developers and the community, due in part to a lack of confidence in consistent government enforcement of environmental standards.

In addition, for non-commercial, community-scale RE, a combination of strong technical support, community education and financial concessions are required. EFE is expected to play an ongoing role with respect to each of the above, continuing the objectives under the Project.

6.7 Information and Regulatory Support is More Significant than Financial Support

Experiences have shown that biomass project developers need and benefit from BCH information and institutional support more than financial support. Several stakeholders noted that the most important support that potential developers need is information, technical and non-technical advice to take full benefit from existing financial and non-financial regulatory support mechanisms. This lesson was demonstrated when BCH management shifted its focus at the time of the mid-term to rank the four main lines of work from the strongest to the least strong as follows: technical, information sharing, policy and finance. In the second half of the Project this order was generally agreed to have changed to: information, policy, technical and finance.

Information services are seen by many stakeholders as the Project's primary strength, and as a major contribution to removing the barrier of limited awareness regarding renewable energy among industry and academics in Thailand. The main information services are the newsletter, publications, web board, phone-in and walk-in. Main outreach activities are seminars and workshops, public education, community participation, and media activities. There are three main target groups: the public, potential developers, and academics. The Project has also catalyzed the GEM programme, which will continue and extend such information and outreach services in Thailand, focused on community-scale generation projects.

For policy and regulatory work, respondents generally agreed that significant RE investment can be encouraged through pragmatic and investor-oriented government

support – with the key challenge for the Project being influencing the policymaker. EFE has had significant achievements in promoting policy. This has been assisted by strong personal links with EPPO and no doubt not harmed by the chairman of the EFE advisory board having served as Minister of Energy during the Project. These special circumstances have clearly been beneficial to the Project in achieving policy successes, but may raise doubts as to how replicable such successes would be for similar GEF/UNDP initiatives in other sectors in Thailand, or for the RE sector in other countries where Project staff do not have similar influence with government.

While a significant and impressive 'step in the right direction', the current policy framework also still offers scope for improvement. Various different suggestions by different stakeholders were made of potential revisions, as documented in Annex 3. This evaluation does not seek to assess the merits of such further policy recommendations, but notes that such recommendations do serve to highlight an ongoing role for expert debate and further policy advocacy by EFE to GOT.

6.8 Public Awareness and Public Opposition—Need to Build Community Support for Change

A major success indicator of any large scale project is the environmental impact and level of acceptance by the community. The REG pilot plant has been successful in raising public awareness concerning biomass power plant operations including not only awareness about the increased value of local resources but also about how biomass co-generation can help reduce GHG emissions. REG established an excellent early record in communicating with the community and thereby a good relationship with the people in the area to ensure that the power plant would help to solve the long-standing problem of rice husk dust and ash from burning rice husk in open space. The second pilot plant, GYG, has established strong relations with the community through a combination of local employment, fuel purchase from local farmers, good public relations and effective communication channels to resolve community concerns as they arise.

The Project's early success in building community support for biomass pilot plants at REG and GTG are exceptions. Public opposition is still a major risk for any (biomass) power plant project. More work on public education and social marketing, on how people can positively contribute to the project, are required in the planning stage of new developments.

In response to the barrier of community opposition, several stakeholders believed that this can generally be managed through good-practice efforts to engage the community and inform them about best practices for RE plants combined with sensitive site selection. Studies and experience showed that smaller scale renewable energy projects have better prospects than medium and large ones. The potential use of other types of renewable energy such as wind, solar and biogas which is derived from biomass are promising especially in terms of public support. At this stage the public has very little awareness of the risks or benefits of these kinds of renewable energy, in spite of the Project's efforts over the past seven years, suggesting that continuing public education or public relations campaigns advocating RE power are required.

6.9 Need for Consistent Focus on Environmental Impacts and Benefits

A principal national objective of the Project is to reduce GHG emissions by accelerating the growth of biomass co-generation and power generation technologies to replace current fossil fuel consumption in Thailand. Annual indicators of climate change impacts have been reported over the life of the Project. M&E reports conclude that biomass is a relatively low cost technology (compared to wind and solar), and does not harm the natural environment in the case that biomass comes from plant residues. Annual CO_2 emissions avoided in 2008 through 398 MW of new biomass plant developments since the start of the Project are estimated at 1,199,722 tons.

In addition, important environmental impacts arising as a result of investments in biomass power projects have been identified during routine M&E. The main example is the REG pilot plant, which initially faced a higher risk of ash particles in the flue gas. Although plant is equipped with a multi-cyclone and an electrostatic precipitator, ash emissions measured were quite high. Over time the problem was rectified, and REG was awarded an ASEAN Energy Award in the "Off-Grid" category of the New and Renewable Sources of Energy Projects in 2004.

At the same time, despite the efforts of the REG plant owners, a smaller, neighboring biomass plant does not effectively control rice husk dust. While community residents do not blame REG, this does undermine the pilot plant's efforts to promote biomass power. A further example of poor biomass plant environmental performance is an early 1990's plant burning rice husk in Chainat province, which suffered low availability and, more significantly to the wider sector, high levels of visible emissions that were taken up by campaigners as justification to oppose biomass plant developments.

These examples highlight that a lesson for the RE sector is consistently high performance with respect to local environmental impacts, best ensured through effective enforcement of national environmental regulation by the relevant authorities. Several stakeholders pointed to lack of consistent enforcement of environmental standards as a barrier to power plant acceptance by local communities, whether the plant is fossil or RE based.

6.10 Risk Guarantee Facility

The pilot plants, REG and GYG, were supported by the Project through total contributions of US$ 3 million towards the fees for a risk guarantee facility for each plant. These guarantee facilities were originally part of a JBIC co-financing package, but lost their immediate relevance once JBIC withdrew. For GYG, the facility did still deliver clear value to the plant as one bargaining chip offered to the lender after security concerns halted construction, to secure debt funding to complete plant construction.

For both pilot plants, several interviewees saw the risk guarantee facility as, in effect, an opportunity to provide a cash grant to the parent or project company. It is possible, given identified vulnerabilities in Project design, that this is how the facility worked in practice.

The risk guarantee facility as a means of financial risk mitigation does not appear to have been effectively demonstrated by the pilots, and the experience has not yet been disseminated. Project management at EFE considered that the pilot projects are a "special case" that could not easily be replicated. This view is backed up by the lack of interested

from domestic FIs in providing such a facility on commercial terms. Constraints related to the biomass market structure in Thailand mean that it is unlikely that such a commercially-provided facility would be a competitively priced means of fuel price risk mitigation, compared with fuel supply management by the plant.

One further drawback to the guarantee facility is that it barred the pilot plants from registering as CDM projects – since the plants were already in receipt of donor support. While the possibility of such registration was uncertain at the time of plant development, it should in hindsight have been possible. At a US$10 CER price, each plant could have received the same amount of revenue as made available through the GEF fund within 4 years.

EFE stated that any similar future guarantee facility would need to be "carefully designed" and is due to produce a risk guarantee study in June 2009, which may provide further relevant lessons relevant to future UNDP/GEF projects that might seek to apply a similar approach. On the basis of evidence so far available, the guarantee facility seems a poor approach to mitigate fuel price risk, which is the main relevant risk specific to biomass plants.

7. Operational Recommendations for Future Projects

7.1 Project Executing Agency

Location of the Project within EFE is a key feature of the implementation structure. EFE and EPPO disagreed when interviewed on whether such Projects should best be implemented within government or by a QUANGO similar to EFE.

Project staff at EFE considered that it is best to run programmes like the Project independently of government, since this both increases the flexibility of what can be done and makes it easier to work with the private sector, without the same constraints faced by government.

EPPO considered that if they had possessed sufficient staff in 2001 to carry out the Project within the ministry this would have made the Project easier to control and reduced the issue of short-term hiring horizon, so that the Project may not have suffered the same disruption or recruitment challenges.

In either case, there was agreement that the Project benefits substantially from being based within an established entity with long term prospects – providing existing staff to help with Project start-up, providing existing name or 'brand' recognition, and providing a vehicle for long-run sustainability after Project funding ceases. Clearer integration of BCH into EFE from the start of the Project may have even helped new recruits to see a longer term employment opportunity.

Key operational recommendations, based on the successful experiences of the Project being run from EFE, are that the executing agency provides:

- Strong links with a range of branches of government and academia, whether itself within or outside of government.
- A stable long-term platform for the Project and complementary activities, both before and after the Project term.
- Strong technical skills for effective engagement with the private sector on project development.

It is difficult to tell without a comparison case how the success of the Project would have been affected if implementation had instead been carried out within the GOT. The example of using a QUANGO for implementation of projects similar to RBBPGC can be said to be generally effective subject to meeting the above bulleted provisions, however.

7.2 Project Governance

Project oversight from the PSC was sufficient for procedural issues but less than optimal for strategic direction given the challenges faced with the evolving RE sector. Similar bodies for future UNDP/GEF projects could likely be improved through greater provision of information to PSC members and more frequent PSC meetings – following the example of the EFE board. The Project was fortunate to benefit from alternative means of oversight as well as a productive working relationship with the UNDP and National

Project Director, however, and is not seen itself to have suffered significantly from a lack of oversight.

The mid-term evaluation remarked that "Given the infrequent PSC meetings, the complexity of the Project, the rolling work plan, the various reporting formats, the substitutions and frequent changes among the ex-officio members – several PSC members have only limited knowledge of the progress of the project and little exchange with BOSCH, and feel that they are only 'contributors', not 'stakeholders' of the Project". This remained true throughout the Project, with a lack of engagement from several PSC members resulting partly from a feeling of limited influence on the Project strategy and limited information about the substance of Project activities.

By comparison with the PSC, the EFE board members were seen to have

- A more direct stake in the Project's success through their long-standing involvement with EFE – which was dedicating the majority of resources to the Project.
- Closer familiarity with BCH's activities, through more regular meetings.
- Better RE sector insight, more relevant resources and better networks at their disposal through their full-time professional roles in their respective organizations.

7.3 Performance Improvement

The Project has been generally successful in providing the target outputs and translating such outputs into relevant outcomes – in particular through information and policy activities.

A lack of staff resources has been the major constraint on the Project performing even better than it has. Specifically, such limited staff resources have led to a trend of delays in deploying budgetary resources to meet the scheduled work plan and to a slightly narrower range of planned activities than may have been optimal. Such staff limitations were mitigated where possible through outsourcing, and have not undermined achievement of any specific objective, though the nature of achievements may have broadened relative to the Project Document partly because of their later deployment given the rapidly changing market context. Constraints on staff recruitment are a perennial challenge for short-term public sector programmes, but in this case the challenge could likely have been reduced through either better Project design – to anticipate potential issues with fee-based work and RE market changes – or through a more vigilant, sustained joint effort by UNDP and EFE to adapt the Project focus gradually to new sector demands – rather than the disruptive refocusing the Project experienced in 2006, with associated staff losses.

M&E design was not considered significantly supportive of the Project and could beneficially have been streamlined, to provide more meaningful information and demand a lower proportion of skilled staff and financial resources. Numerically intensive indicators should in many cases be reduced (e.g. for policy outcomes), and the use of the remaining quantitative indicators reinforced by qualitative indicators, in particular to provide a longer-term perspective on Project impacts (e.g. a 4-year retrospective).

7.4 Conclusion: Assessment of Overall Project Performance

The Project has in general been a remarkable success, all the more so for the outcomes achieved in the face of challenges in appropriate design relative to a fast-evolving market, staffing, and early institutional upheaval.

Best Project initiatives cited, and focused during the second phase, were:

- Policy work on the "adder" reform, including the early wind and solar study
- Community-level refocusing under the GEM
- Information resources, including in particular the Biomass Manual as well as remodeling of website, seminars, newsletter, biomass resource data and media campaign
- Technical support to developers for biogas plants

Shortcomings, by contrast, relate to difficulty in engaging positively with the financial sector and the limited public value of the guarantee facility provided to the pilot plants. In these respects the Project team has fulfilled their duties under the Project Document, but the outcomes for the RE sector in terms of barrier removal are limited relative to other areas of activity.

Many rich lessons have been learned from the eight-year experience, which have been generously and openly shared with the evaluation team by a wide range of Project staff, stakeholders and beneficiaries.

The current positive state of the RE sector in Thailand is concluded to owe a significant amount to EFE's activities as supported by the Project, as well as to a dynamic private sector and a supportive public policy environment.